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VOLUME NO. IV

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1947

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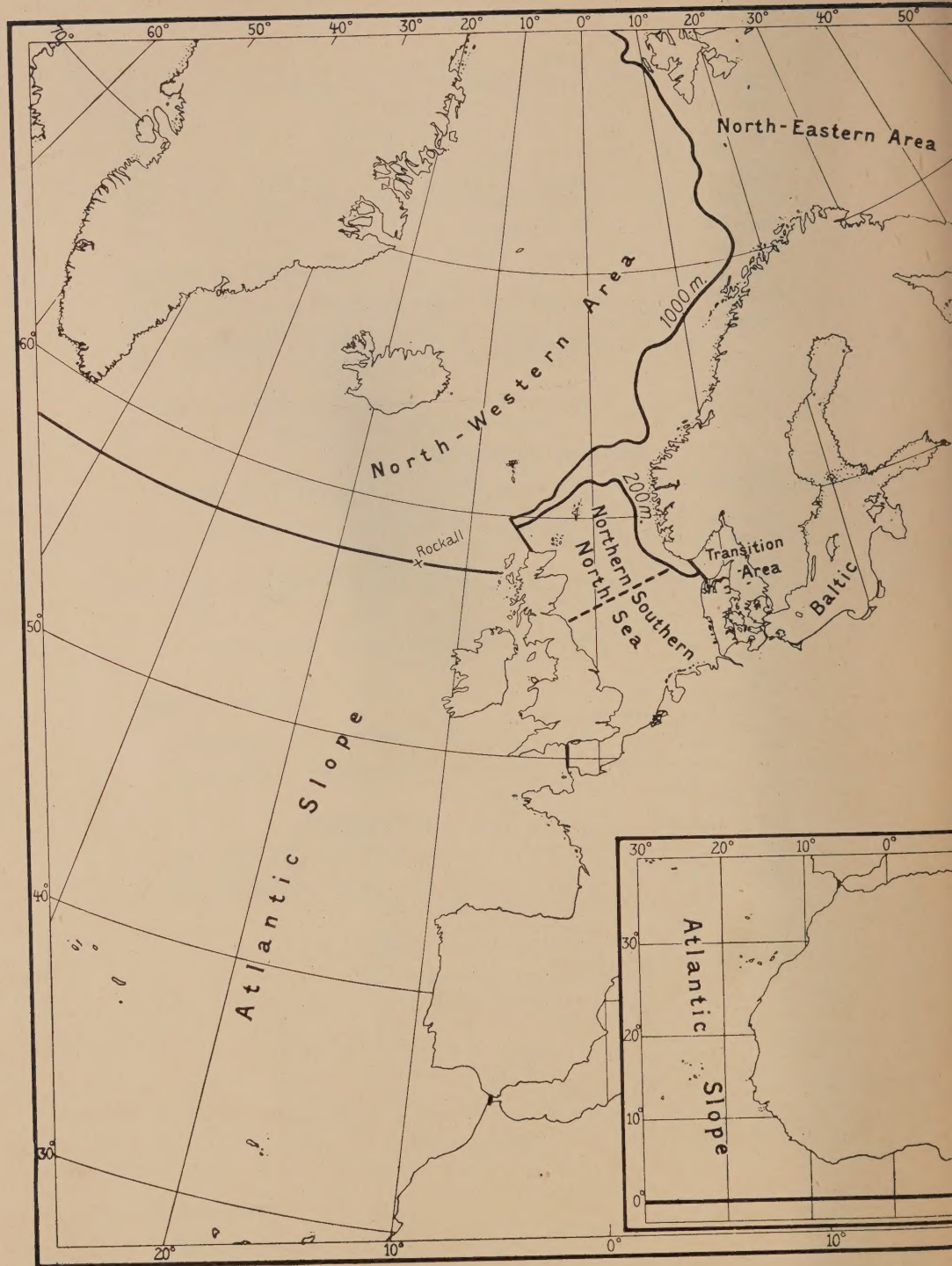
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The Areas and their Limits.
 For the Transition Area see also the Map on p. 122.

North-Western Area.

INTRODUCTION.

The contributors to this report from the North-western Area are the following:

Mr. E. Bertelsen, Copenhagen.
Mr. Finn Devold, Bergen.
Dr. Hermann Einarsson, Reykjavik.
Mr. J. H. Fraser, Aberdeen.
Mr. Árni Fridriksson, Reykjavik.
Mr. Frede Hermann, Copenhagen.
Mr. Jón Jónsson, Reykjavik.
Mr. B. B. Parrish, Aberdeen.
Dr. B. B. Rae, Aberdeen.
Mr. Jens Smed, Copenhagen.

Mr. Árni Fridriksson has kindly submitted some analyses of herring samples from the area for inclusion in the report.

The **hydrographical** contribution to the present report emphasizes the general impression of a rise in temperature in the last 20—25 years in northern waters. The hydrographic conditions in the Faroe Channel and north of Iceland in July 1947 were nearly normal compared with observations in the same season in pre-war years.

Observations on **plankton** and **bottom animals** are included and ought to be increased. In the report the difference between the plankton of the Faroe area and the plankton of the Scottish area and the Faroe Channel is emphasized.

Of much interest is the **increase in fry** of cod, haddock and coalfish in Faroese waters after the war when a certain protection of the spawning grounds of these species took place.

The stock of **haddock** in 1947 consisted mainly of the year-classes 1944, 1945 and 1946, with the 1945 brood as the best. The **lemon sole** stock at

the Faroes shows now, after the war, a decrease in the accumulated larger fish.

From the Icelandic area we have an important contribution to the **herring** question of this area. It is a report on the unexpectedly very great winter fishery of herring in Faxa Bay. The analysis of the stock has shown that the fishery was based on the indigenous summer spawning and spring spawning herring, which is morphologically different from the spring spawning stock, fished for in the summer, north of Iceland.

The fishery on the north Iceland herring stock in the summer of 1947 is shown in a series of maps, which, it is hoped, will be given every year. The correspondence between *Calanus* density and the density of herring off north Iceland has been studied during pump experiments and the results seem promising.

The main spawning of **cod** in Icelandic waters takes place off the south and west coast; during recent years increased spawning has, however, been observed off the north coast and seems to have been induced by the general rise in temperature in northern waters.

The **lemon sole** stock in Faxa Bay in 1946 showed a very rich 1941 year-class. The number of smaller fish in this bay is increasing while that of fish larger than 40 cm. is decreasing.

A study of the spawning of fish in south and south-west Iceland during the early spring was carried out in 1947 and gives very valuable information for this season which has hitherto been only little investigated.

On the **Greenland cod** stock a paper by Paul M. Hansen will appear in the *Procès-Verbaux* series during 1948 including all recent data; observations on this item are accordingly omitted here.

A. Vedel Tåning.

ENVIRONMENT.

Hydrographic Conditions in the Faroe-Shetland Channel in July 1947

During July 19th and 20th, 1947, the Danish research vessel "Dana" under the leadership of Dr. Å. Vedel Tåning undertook hydrographic investigations along a section across the Faroe-Shetland Channel (Fig. 1). The data will be published in the "Bulletin Hydrographique" 1947.

Fig. 2 gives a section showing isotherms and isohalines. On the basis of temperature and salinity data dynamic calculations were carried out in order to find the current velocity and the water transport through the section. The values of the velocity perpendicular to the section are given in the diagram (Fig. 3) for the various intervals of depth between the stations. Positive values indicate that the current has a north-easterly direction.

The values marked 1) are based on the supposition that the zero-surface — i.e., the surface where the horizontal pressure gradient equals zero

Fig. 1. Location of Stations. ➔

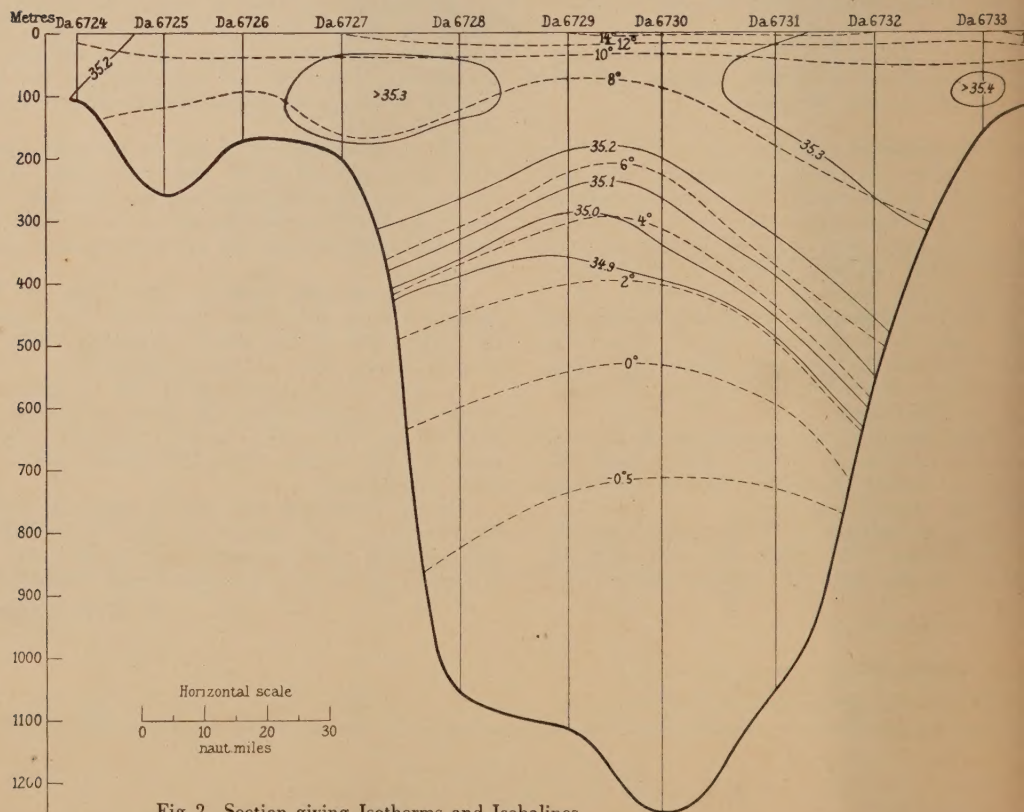
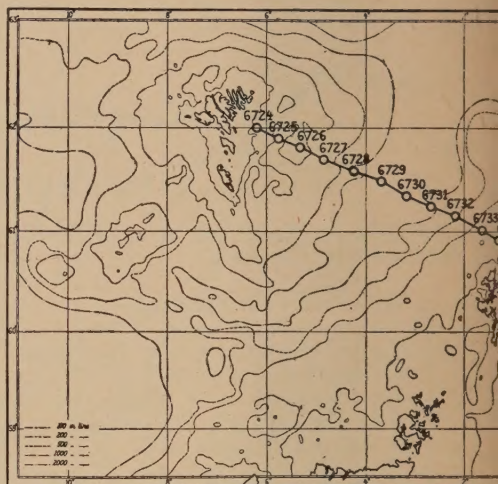


Fig. 2. Section giving Isotherms and Isohalines.
NB. Correction: The isohaline marked 34.9 should read 34.95.

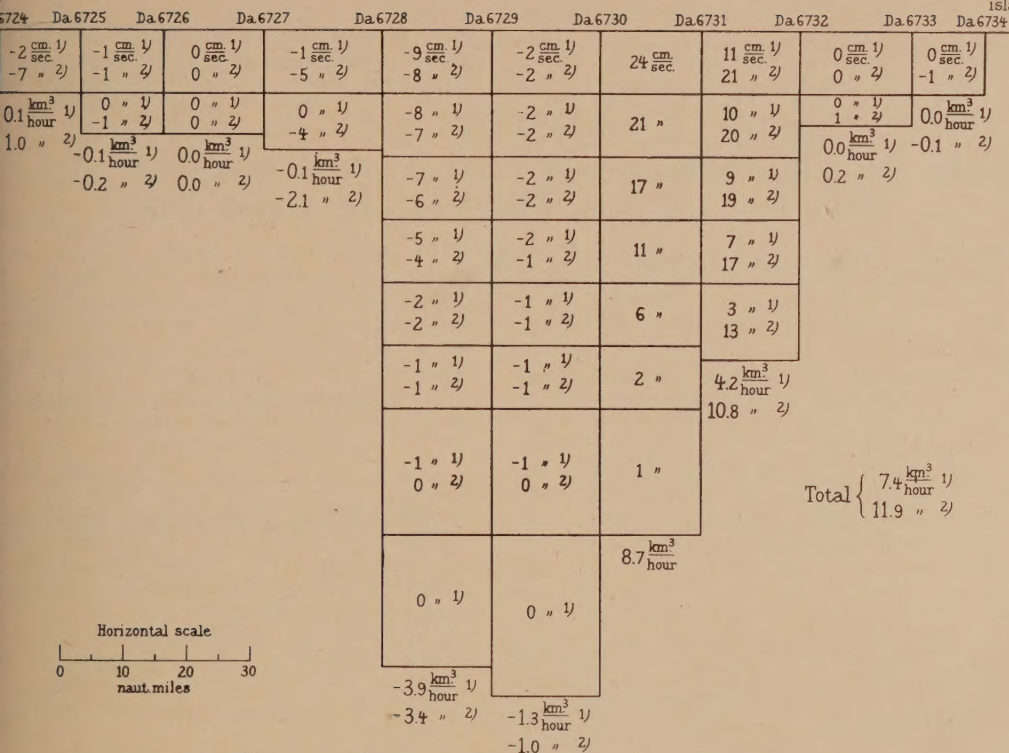


Fig. 3. Current and Intensity of Flow through the various parts of the section.

tuated as shown by the bottom line of the in the diagram. This means that the zero for the interval is supposed to coincide is isobaric surface at the bottom of the sta-h the smallest depth.

values marked 2) are based on the sup-that the zero surface coincides with the surface at 800 m., and with the bottom this less than 800 m.

below the bottom line in Fig. 3 are for erval recorded two values for the intensity e flow through the interval in question. The are based on the same supposition to the a of the zero-surface as was used for the es.

It is seen from Fig. 3 that the inflow takes place in the south-eastern part of the section and the outflow in the north-western part. This is a common feature.

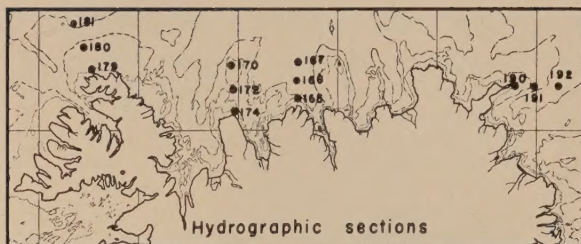
The two values for the whole flow through the section are recorded under "Total" in Fig. 3. The value marked 2) should be regarded as the more accurate, but must be taken with some reserve as the correction is rather uncertain.

Literature.

Jacobsen 1943, Rapp. et Proc.-Verb., CXII.
Jens Smed. Ann. Biol. Vol. III, 1946, p. 4.

Frede Hermann.

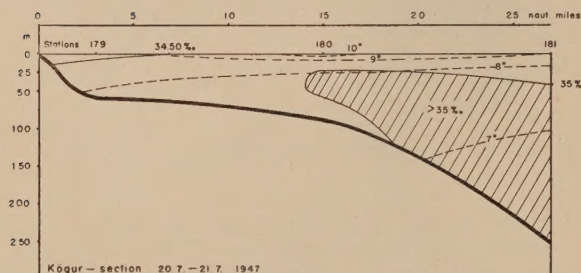
Influx of Atlantic Water north of Iceland 1947.



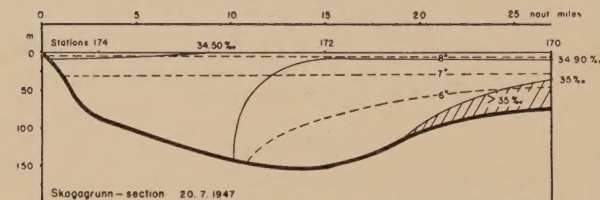
a

Fig. 4. Hydrographic Sections taken at North Iceland during July and August, 1947.

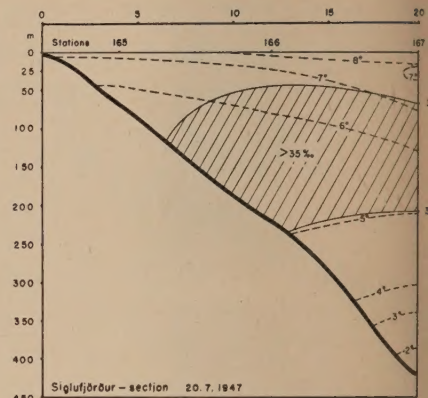
- a) Location of Sections.
- b) Kögur Section, 20.7.—21.7.
- c) Skagagrunn Section, 20.7.
- d) Siglufjörður Section, 20.7.
- e) Langanes Section, 26.7.
- f) Langanes Section, 26.8.



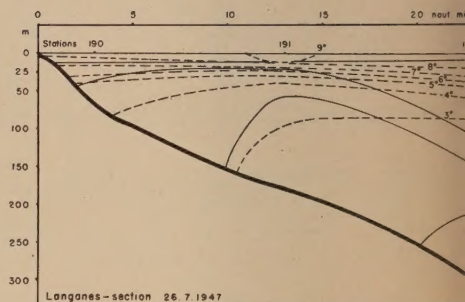
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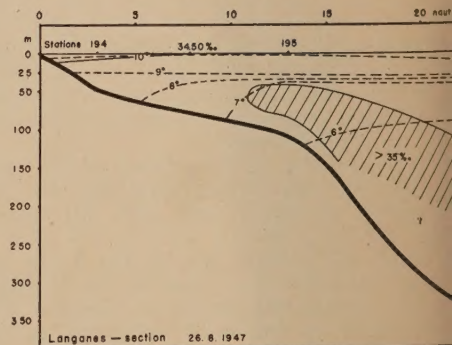
c



d



e



f

Atlantic water was observed in the western part of the northern slope waters during the *latter half of July* 1947. It did not reach as far as Langanes, however, as shown by the accompanying diagrams. It reached the bottom in the outer half of the Kögur section, and on Skagagrunn it constituted a thin bottom layer. In the Siglufjörður section it was observed as an intermediate layer, between 50 and 200 m. depth, at the two outer stations.

This seems to be very near the mean for July-August 1924—1933 as shown by Tåning (Biol. I, p. 81). No arctic water of less than 34.50‰ was encountered in these sections.

Four sections show the situation in late July when the herring fishery had come to an end in the western part, but was at its height around Sey and especially on the eastern grounds south of Langanes.

information on the hydrographic situation during latter half of the herring season is incomplete, the situation must have altered a great deal. The Langanes section was repeated on August and the diagram (see 4 f) shows that warm

Atlantic water had now entered the section, the temperatures being considerably higher than in late July.

For comparison with earlier years we refer to Tåning's account in *Ann. Biol.*, Vol. I, p. 81—82.

Hermann Einarsson.

Monthly Anomalies of the Surface Temperature in the Sea round Iceland during the Years 1876—1939 and 1945—1947.

In two previous papers (Smed, 1947, 1948) monthly anomalies of the surface temperature for the years 1876—1939 were given for various parts of the north-western North Atlantic. As such information may be of some value for the study of the problem of climatic and ecological changes in northern waters it was found reasonable to carry out these investigations. In this paper are given anomalies for some areas and stations in the sea round Iceland.

The areas dealt with are indicated in Fig. 5. They are F: 60° — 63° N., 20° — 30° W.; G: 63° — 66° N., 20° — 30° W.; H: 60° — 63° N., 10° — 20° W.; I: 63° — 67° N., 10° — 20° W. The data used have been collected by the Danish Meteorological Office. The data for the years 1912—1947 were compiled from the *Nautisk Meteorologisk Aarbog* while the data for the years 1876—1911 were kindly placed at my disposal by Mr. Helge Thomsen, Head of the Nautical Section of the Danish Meteorological Office.

The data available were temperature means for each month and each 1° -square. These means have been compared to the grand monthly means for the period 1876—1915, published by Ryder (1917). The anomalies computed in this way were then averaged over the areas F, G, H and I. As to the details of the calculation the reader is referred to the previous papers cited above.

The results are given in Tables 1—4 where the monthly anomalies are recorded together with the numbers of observations on which they are based. A graphic presentation of the results is given in Figs. 6 and 7.

For the areas H and I there is a conspicuous predominance of positive anomalies from about the middle of the twenties. This rise of temperature is especially pronounced for the northernmost area, and in comparison with this the rise of temperature in areas F and G appears to be only small.

While for the war years no observations from the areas considered were available there are some for the post-war years. On the basis of these the anomalies recorded in Table 5 were calculated. It appears that positive anomalies are still very predominant. On an average the anomalies are highest for area I, lowest for area F.

In addition hereto (see overleaf) we will consider the extensive material from 4 permanent stations on the coast of Iceland, viz., Vestmannaeyjar

($63^{\circ}26'$ N., $20^{\circ}15'$ W.) in the south, Stykkishólmur ($65^{\circ}05'$ N., $22^{\circ}46'$ W.) in the west, Grimsey ($66^{\circ}32'$ N., $18^{\circ}00'$ W.) in the north and Papey ($64^{\circ}35'$ N., $14^{\circ}10'$ W.) in the east. The stations are indicated in Fig. 5 by the letters Ve, St, Gr and Pa respectively. At these stations daily observations of the surface temperature have been carried out since 1873 (at Vestmannaeyjar from 1877 only). On account of the position of the stations the temperatures are somewhat influenced by the land. This influence may, however, be supposed to be nearly the same from one year to another. The temperature variations from year to year at these stations may therefore be taken as relatively representative of the fluctuations in the temperature in the sea outside. On the other hand, the fact that the observations have been carried out daily, and at fixed positions, gives this material a special value.

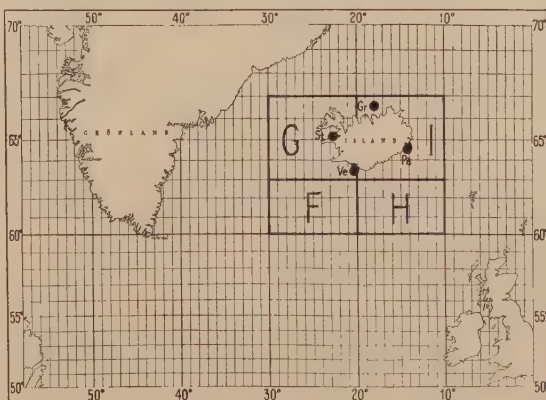


Fig. 5. Location of areas and stations.

For each station, monthly means for each year in the period 1873—1915 were published by Ryder in his paper cited above. These data were used for the present investigation. For the period 1916—1919 the monthly means were compiled from *Meteorologisk Aarbog*, for 1920—1923 from *Islands Vedurfarsbók* and for 1924—1942 from *Vedrattan*. These data have been compared with the grand monthly means for the period 1876—1915 published by Ryder (loc. cit.). The anomalies found are plotted in Figs. 8 and 9. It must be mentioned that some of the monthly means are

cont. p. 26

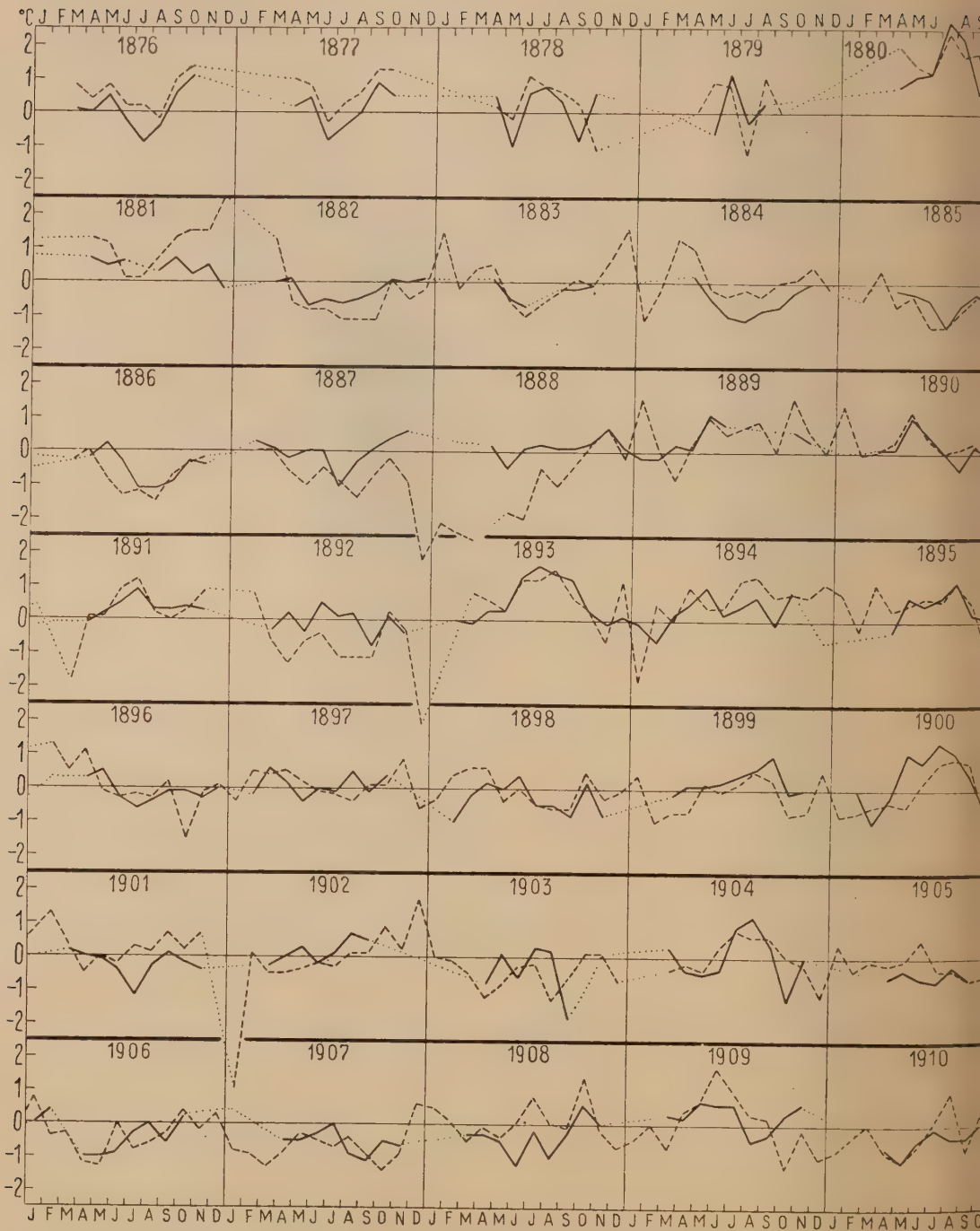


Fig. 6. Monthly anomalies of the surface temperature.
Solid lines: annual mean; dashed lines: monthly mean.

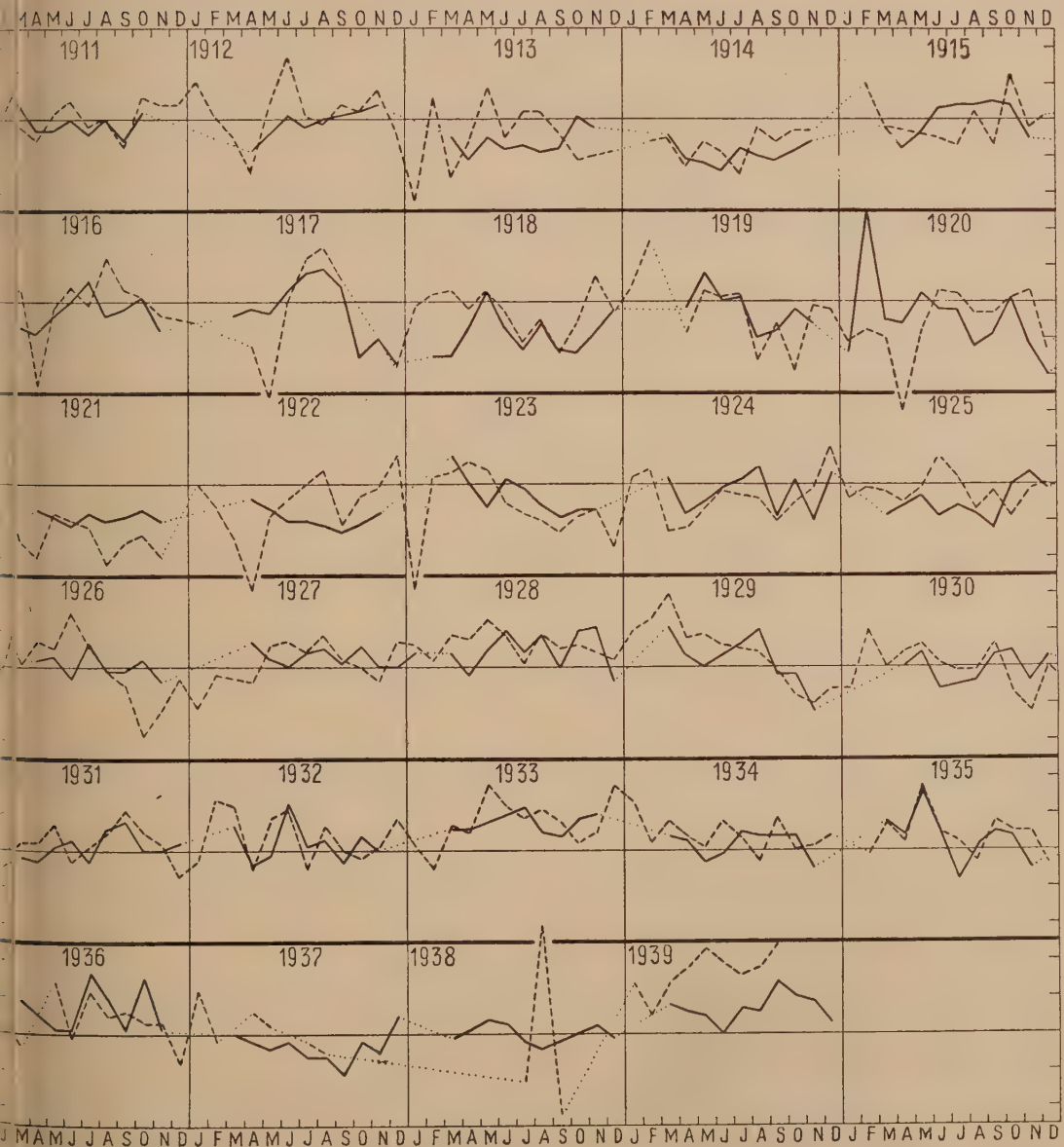


Fig. 5. Hydrographic data for the NW-Area (see Fig. 5) during the years 1876—1939.
— lines: area G.

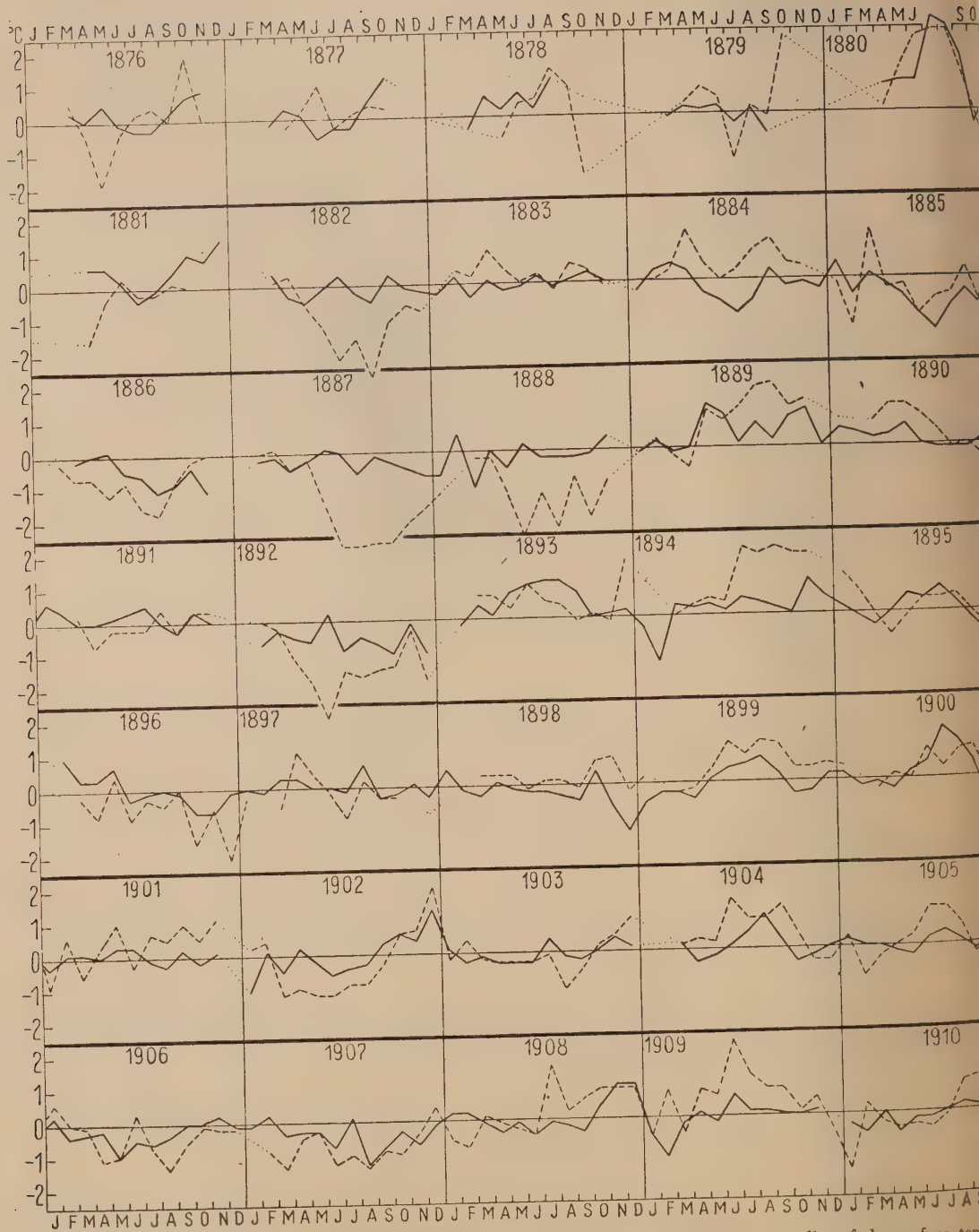
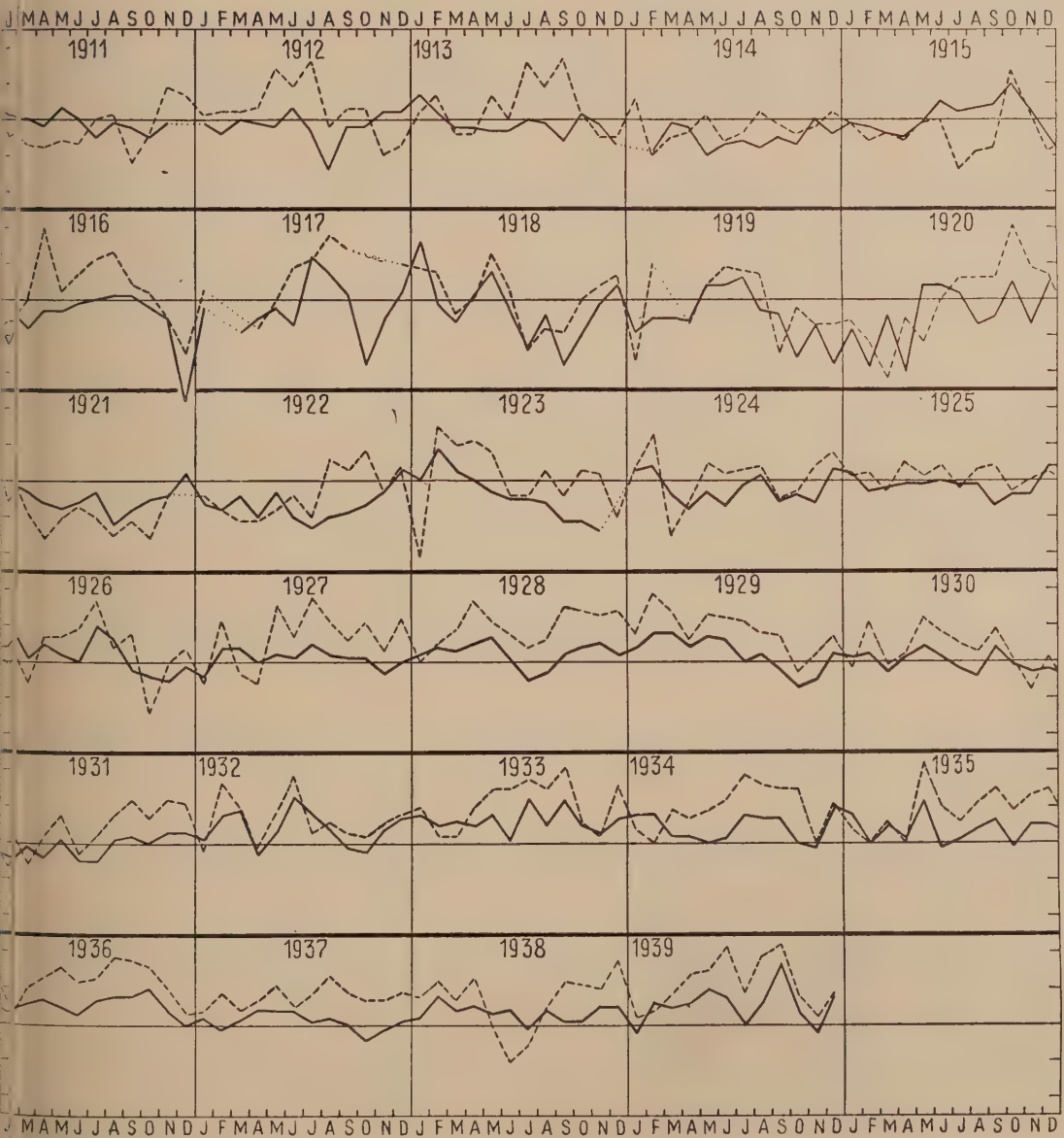


Fig. 7. Monthly anomalies of the surface temperature.
Solid lines: ...



the areas H and I (see Fig. 5) during the years 1876—1939.
solid lines: area I.

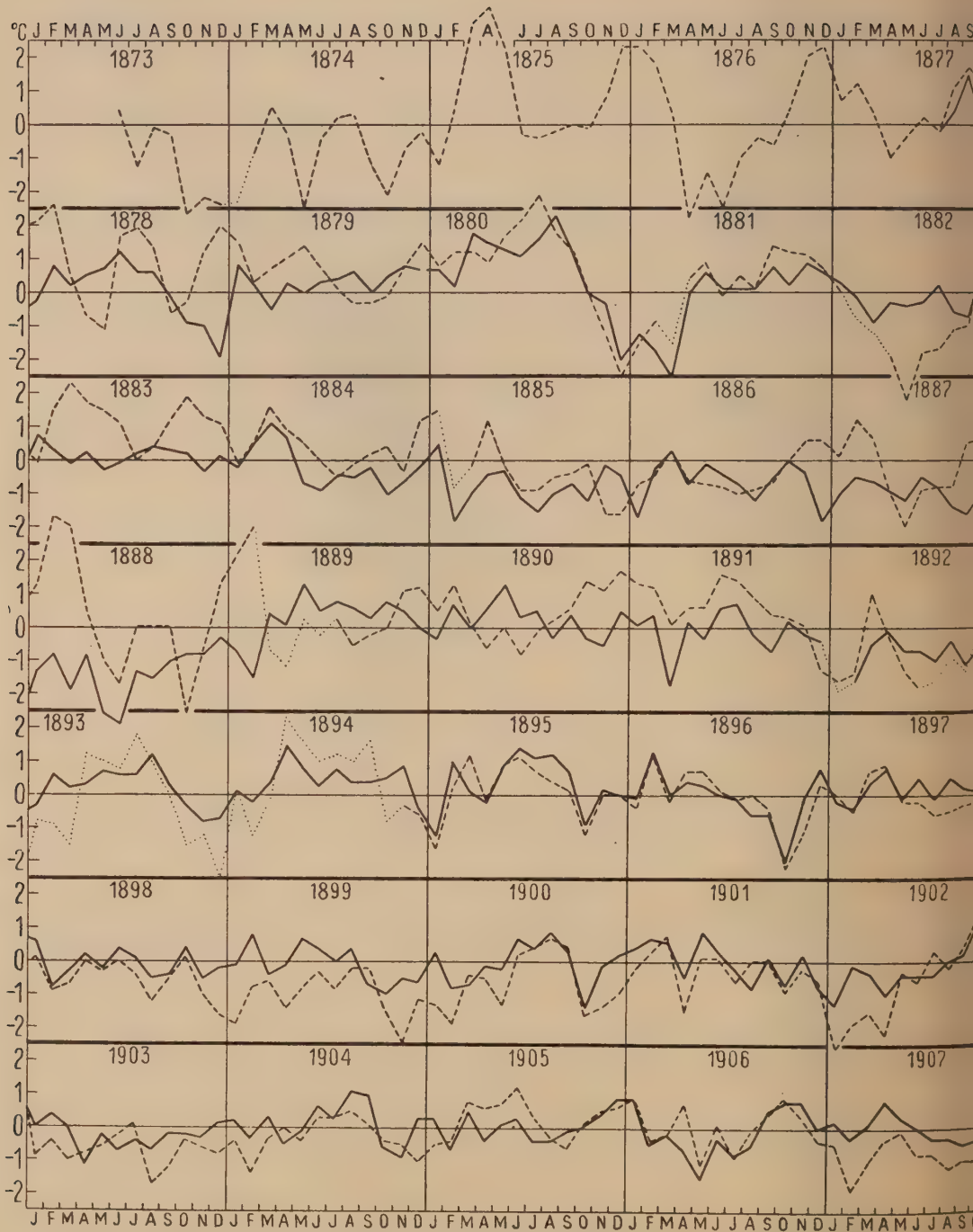
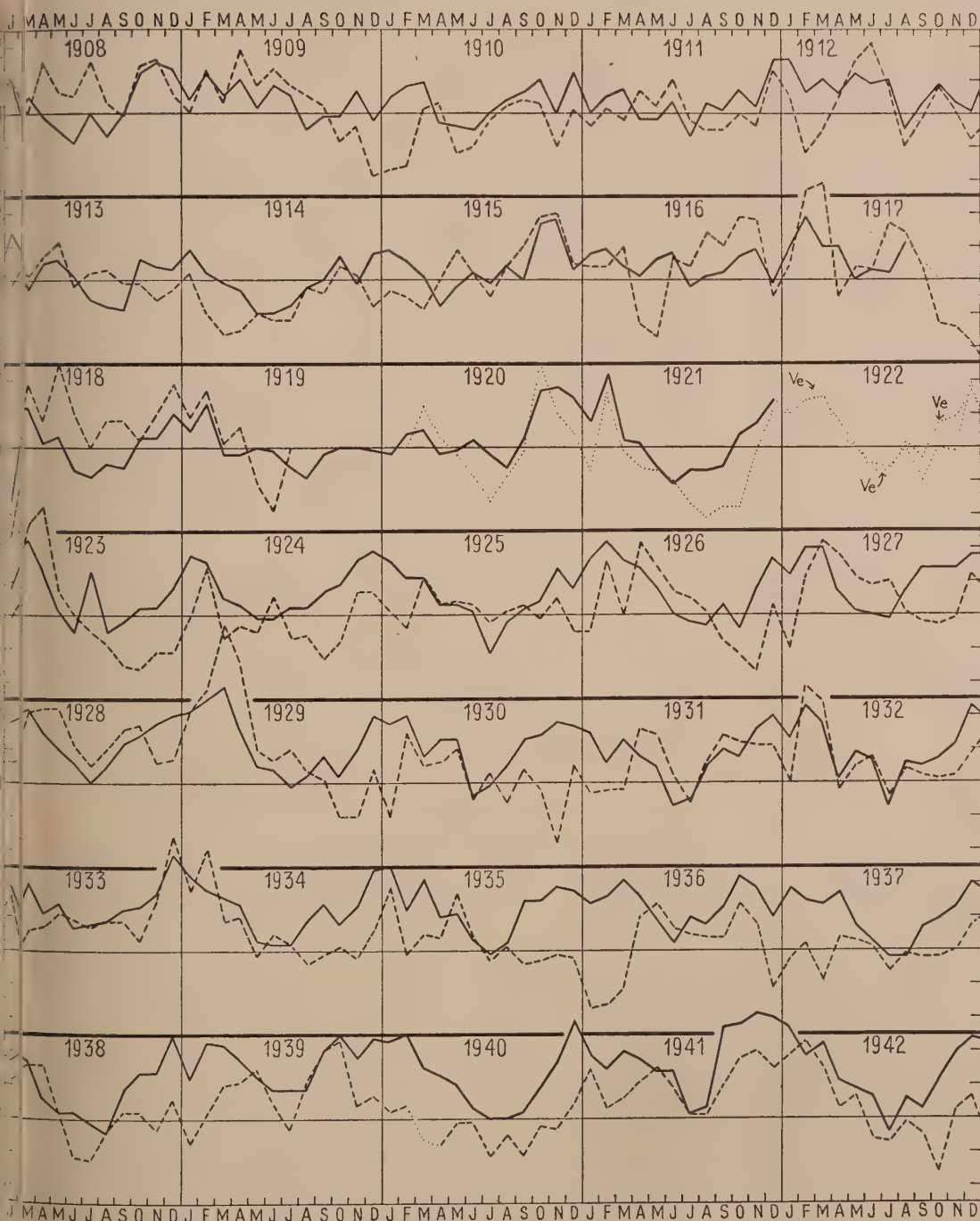


Fig. 8. Monthly anomalies of the surface temperature at the
Solid lines: Vestmann



Stykkishólmur and Stykkishólmur (see Fig. 5) during the years 1873—1942.
solid lines: Stykkishólmur.

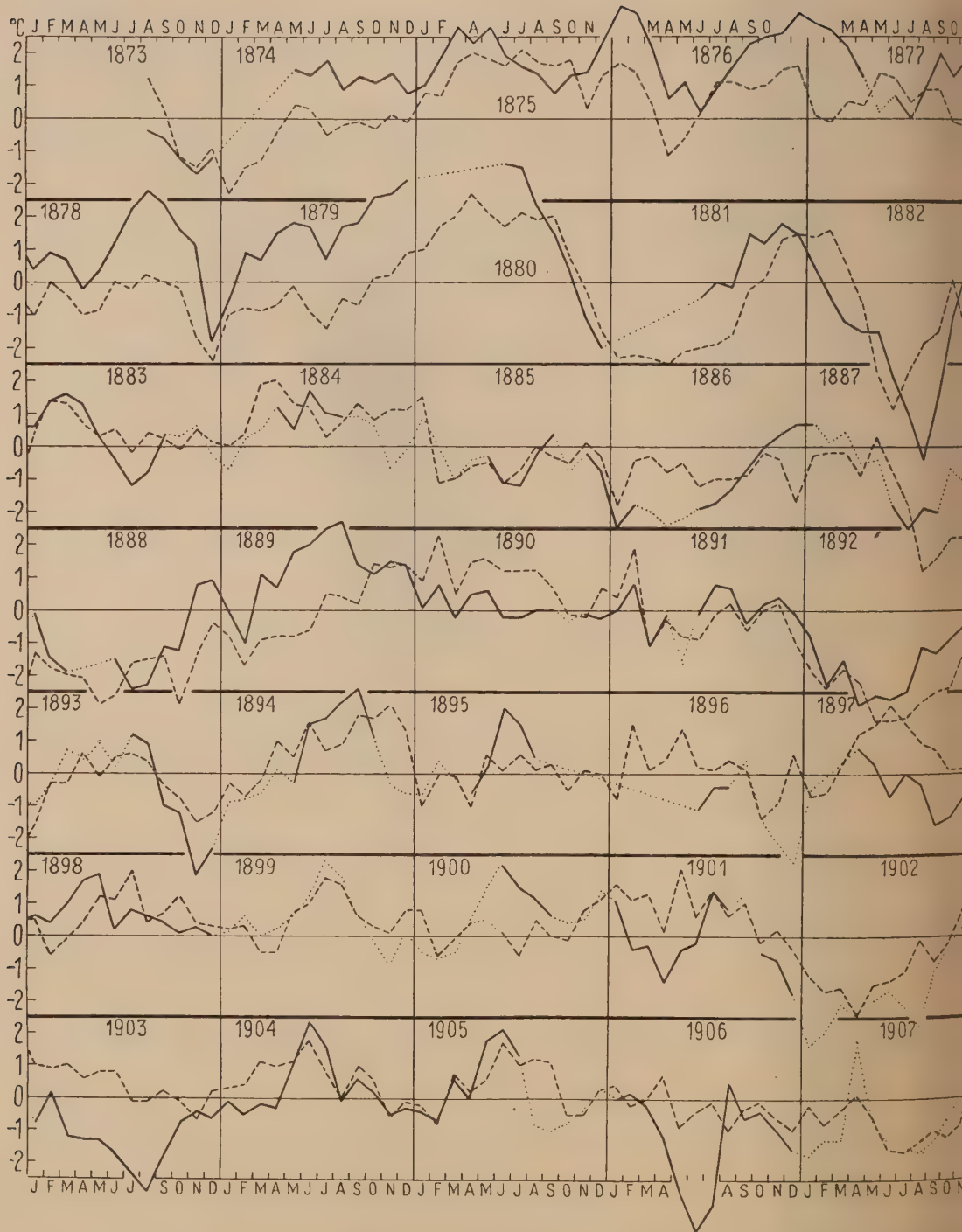
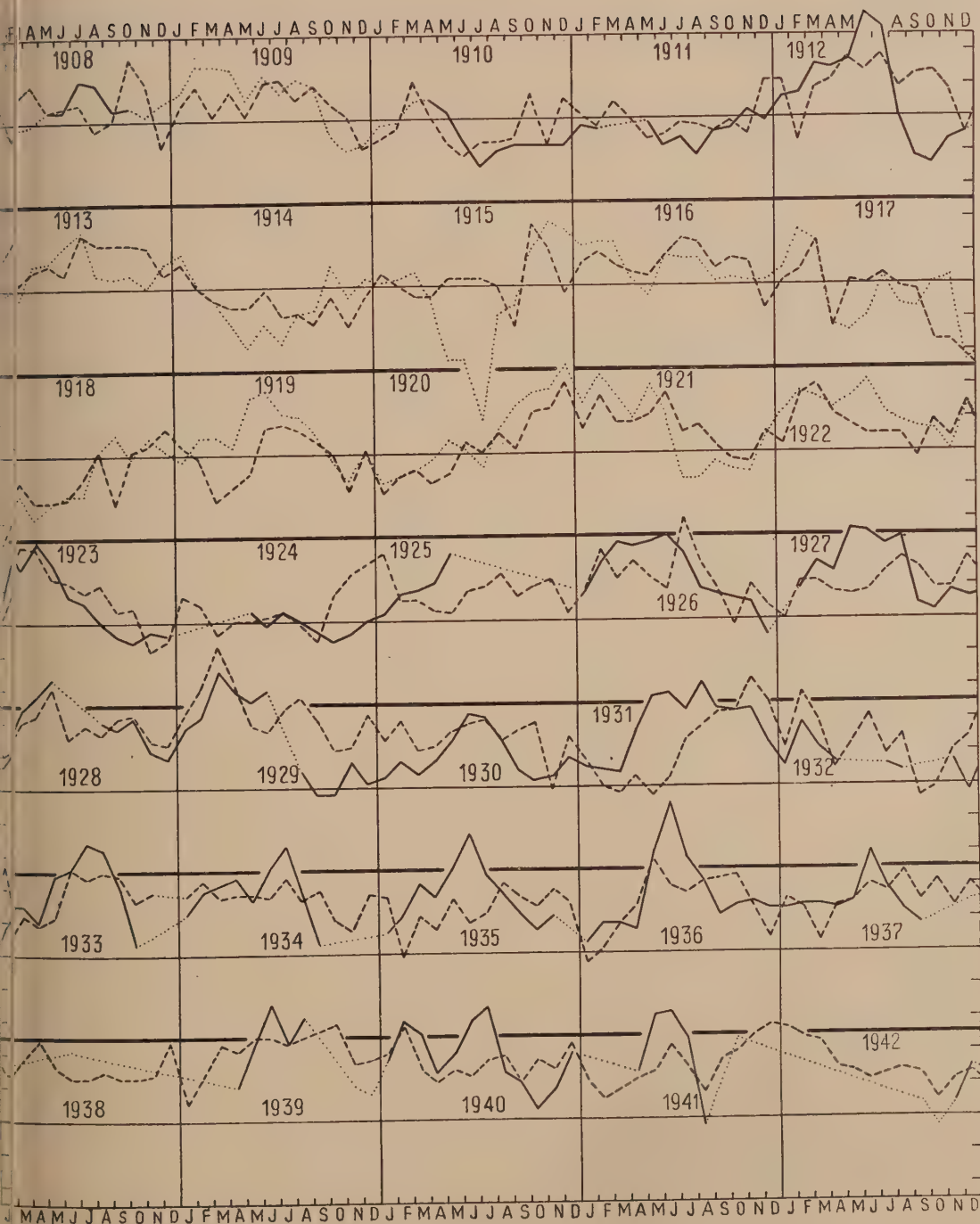


Fig. 9. Monthly anomalies of the surface temperature at the sta
Solid lines: G



ley and Papey (see Fig.5) during the years 1873—1942.
solid lines: Papey.

	January		February		March		April		May		June		July		August		September		October		November		December	
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n
1896	—	—	1.3	6	0.5	14	1.1	42	-0.1	121	-0.3	95	-0.2	65	-0.3	55	0.2	22	-1.5	35	-0.1	16	0.1	12
1897	-0.4	1	0.5	3	0.4	19	0.5	35	0.2	44	-0.1	60	-0.2	58	-0.4	76	0.1	43	0.1	40	0.9	13	-0.6	3
1898	-0.3	4	0.4	7	0.6	9	0.6	35	-0.4	69	0.0	65	-0.5	57	-0.6	62	-0.6	28	0.5	28	-0.3	6	-0.1	3
1899	-0.4	2	-1.0	11	-0.7	29	-0.7	78	0.2	56	-0.1	60	0.1	63	0.5	63	0.3	32	-0.8	28	-0.7	20	0.5	11
1900	-0.8	1	-0.7	11	-0.5	19	-0.4	52	-0.5	60	0.2	66	0.8	46	0.9	75	0.8	49	-0.7	44	0.2	34	0.3	12
1901	0.8	2	1.3	8	0.4	26	-0.5	64	0.0	70	-0.2	59	0.3	68	0.1	72	0.7	26	0.2	28	0.7	12	—	—
1902	-4.0	3	0.1	15	-0.5	27	-0.5	61	-0.4	59	-0.2	67	-0.3	42	0.1	56	0.1	48	0.9	28	0.2	16	1.7	4
1903	0.0	7	-0.1	6	-0.5	9	-1.2	41	-0.8	34	-0.3	42	-0.2	58	-1.3	49	-0.6	31	0.1	25	0.1	15	-0.7	12
1904	—	—	—	—	-0.4	26	-0.2	30	-0.4	53	0.3	25	0.8	32	0.6	47	0.6	32	0.0	14	-0.2	21	-1.2	14
1905	0.4	8	-0.4	5	-0.1	29	-0.2	40	-0.1	52	0.5	50	-0.4	39	-0.4	63	-0.7	42	-0.6	37	-0.1	23	-0.3	19
1906	0.8	10	-0.4	27	-0.3	28	-1.2	36	-1.3	62	0.0	34	-0.8	36	-0.6	34	-0.3	24	0.4	18	-0.2	22	0.3	15
1907	-0.8	11	-0.9	17	-1.3	28	-0.9	45	-0.3	45	-0.5	68	-0.7	50	-0.4	61	-0.9	42	-1.4	31	-0.9	41	0.6	9
1908	0.5	4	0.1	12	-0.5	13	-0.1	37	-0.4	27	0.0	26	0.8	22	0.0	55	-0.1	42	1.4	17	-0.2	22	-0.7	16
1909	-0.5	13	0.0	8	-0.7	12	0.4	18	0.7	31	1.7	40	1.0	48	0.3	39	0.2	41	-1.3	15	-0.2	19	-1.0	13
1910	-0.8	8	-0.4	11	0.0	1	-0.8	31	-1.1	16	-0.6	33	0.1	30	1.0	20	-0.8	24	0.3	37	-0.4	42	1.0	14
1911	0.0	10	0.9	23	-0.2	30	-0.6	12	0.1	44	0.5	34	-0.2	33	0.0	34	-0.8	16	0.6	21	0.4	4	0.4	4
1912	1.0	19	0.1	174	-0.5	238	-1.5	72	0.4	177	1.7	78	0.1	218	-0.1	87	0.4	33	0.2	246	0.8	126	-0.3	37
1913	-2.2	7	0.6	54	-1.6	112	-0.6	168	0.9	165	-0.5	240	0.2	115	0.2	171	-0.4	190	-1.1	140	-1.0	123	-0.9	16
1914	—	—	-0.6	10	-0.5	77	-1.3	64	-0.6	73	-0.9	90	-1.5	58	-0.2	31	-0.6	32	-0.3	65	-0.3	12	—	—
1915	—	—	1.0	4	-0.2	4	-0.3	8	-0.4	7	-0.5	5	-0.7	42	0.2	19	-0.7	12	1.2	27	-0.2	6	0.1	9
1916	—	—	0.2	17	0.3	13	-2.3	1	-0.2	78	0.4	40	-0.1	22	1.2	31	0.3	37	0.1	20	-0.4	20	-0.5	6
1917	-0.6	6	—	—	—	—	-1.2	8	-2.6	5	0.0	25	1.2	7	1.5	6	0.6	8	—	—	—	—	-1.8	8
1918	-0.1	6	0.2	11	0.3	5	-0.2	20	0.3	7	-0.3	10	-1.1	17	-0.5	38	-1.4	17	-0.6	6	0.7	6	-0.3	3
1919	0.4	2	1.7	3	—	—	-0.9	5	0.3	43	0.1	21	0.2	29	-1.6	11	-0.6	23	-1.9	18	-0.1	4	-0.2	12
1920	-1.1	19	-0.8	8	-1.0	5	-3.0	16	-0.8	17	0.3	28	0.2	53	-0.3	31	-0.3	36	0.1	36	0.3	28	-1.3	10
1921	—	—	0.1	4	-1.6	14	-2.0	36	-0.8	23	-1.0	24	-1.2	13	-2.2	18	-1.6	27	-1.4	38	-2.0	15	—	—
1922	0.0	22	-0.6	22	-1.5	47	-2.9	41	-0.9	43	-0.4	20	0.0	40	0.4	41	-1.1	62	-0.3	43	-0.1	31	0.8	26
1923	-2.9	22	0.2	33	0.3	28	0.6	32	0.4	33	-0.5	60	-0.8	47	-1.0	53	-1.3	64	-0.9	73	-0.7	36	-1.7	7
1924	0.2	8	0.4	13	-1.3	55	-1.2	82	-0.7	35	-0.2	43	-0.3	69	-0.4	70	-1.0	81	-0.5	78	-0.1	69	1.0	6
1925	-0.4	14	-0.1	37	-0.2	91	-0.5	49	-0.1	59	0.8	28	0.2	23	-0.7	22	-0.2	21	-0.9	76	-0.1	38	0.0	11
1926	-0.1	12	1.2	91	0.1	85	0.7	60	0.5	31	1.5	52	0.6	36	-0.1	93	-0.5	58	-1.9	49	-1.2	24	-0.3	11
1927	-1.1	14	-0.2	51	-0.3	64	-0.4	49	0.6	49	0.7	78	0.4	43	0.9	54	0.2	54	0.0	54	-0.4	30	0.7	7
1928	0.6	7	0.2	25	0.9	29	0.8	9	1.3	41	0.9	105	0.1	69	0.9	75	0.5	53	0.6	40	0.4	21	0.2	6
1929	1.0	11	1.3	39	2.0	57	0.8	40	0.9	61	0.6	65	0.5	70	-0.8	78	-0.1	51	-0.8	116	-1.0	70	-0.6	20
1930	-0.6	7	1.0	25	0.0	37	0.4	49	0.6	74	0.1	56	-0.1	68	-0.1	88	0.7	71	-0.7	87	-1.2	68	0.0	21
1931	—	4	-0.3	36	0.2	57	0.2	65	0.7	86	-0.3	29	0.1	94	0.5	91	1.1	106	0.5	52	0.2	86	-0.7	11
1932	-0.3	3	1.4	37	1.2	46	-0.5	45	0.9	36	1.1	62	-0.5	64	0.7	50	0.0	95	-0.2	47	0.1	41	0.9	21
1933	0.1	12	-0.5	45	0.7	78	0.5	54	1.8	41	1.2	60	0.9	49	1.1	71	0.8	111	0.2	28	0.5	27	1.8	10
1934	1.3	8	0.2	17	0.8	41	0.4	35	0.1	60	0.8	54	0.3	50	-0.3	37	0.9	48	0.0	32	0.1	27	0.4	19
1935	—	—	-0.1	22	0.7	69	0.2	59	1.8	40	0.5	36	0.2	29	-0.3	31	0.8	47	0.5	50	0.5	37	-0.4	12
1936	—	—	0.3	14	-0.4	19	—	—	1.4	21	-0.1	13	1.1	18	0.5	31	0.6	44	0.3	29	0.3	29	-0.8	3
1937	1.2	1	-0.2	2	—	—	0.6	2	0.2	4	—	—	-0.2	11	-0.5	24	—	—	—	—	—	—	—	—
1938	—	—	—	—	—	—	—	—	—	—	—	—	-1.3	48	3.0	1	-2.2	6	—	—	—	—	—	—
1939	1.4	3	0.5	5	1.4	3	1.8	18	2.3	11	1.9	16	1.6	28	1.8	25	2.5	7	—	—	—	—	—	—

Tables 1a & 2a. Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Areas F and G (see Fig. 5) during the Years 1876-1895. (1896-1939 see preceding pages).

Area F	January		February		March		April		May		June		July		August		September		October		November		December	
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n
1876	—	—	—	—	0-1	1	0-0	25	0-5	18	-0-2	19	-0-9	12	-0-4	7	0-6	34	1-1	25	—	—	—	—
1877	—	—	—	—	0-2	5	0-5	18	0-5	18	-0-8	1	-0-4	2	0-0	2	0-9	13	0-5	5	—	—	—	—
1878	—	—	—	—	0-5	19	-1-0	1	-1-0	1	0-6	8	0-8	9	0-4	10	-0-8	1	0-6	2	—	—	—	—
1879	—	—	—	—	-0-1	2	—	—	-0-6	15	1-2	3	-0-3	3	0-3	4	—	—	—	—	—	—	—	—
1880	—	—	—	—	—	—	0-8	17	1-1	11	1-2	2	2-7	1	2-2	11	0-6	3	1-0	2	—	—	—	—
1881	—	—	—	—	—	—	0-7	5	0-5	24	0-6	3	—	—	0-3	8	0-7	28	0-2	14	0-5	5	-0-2	1
1882	—	—	—	—	0-0	1	0-1	25	-0-7	42	-0-5	8	-0-6	4	-0-5	21	-0-3	7	0-1	27	0-0	13	0-1	3
1883	—	—	—	—	—	—	0-1	17	-0-5	6	-0-7	15	—	—	-0-2	3	-0-2	11	-0-1	6	—	—	—	—
1884	—	—	—	—	—	—	0-2	4	-0-5	14	-1-0	9	-1-1	1	-0-8	15	-0-7	10	-0-3	10	0-0	3	—	—
1885	—	—	—	—	—	—	-0-2	11	-0-3	2	-0-5	6	-1-3	5	-0-6	9	-0-3	25	-0-6	22	-0-7	13	—	—
1886	—	—	—	—	—	—	-0-2	26	0-2	2	-0-3	3	-1-1	10	-1-1	9	-0-9	27	-0-3	23	-0-4	5	—	—
1887	—	—	—	—	0-1	6	-0-2	27	0-0	19	0-0	37	-1-0	4	-0-3	53	0-1	6	0-4	19	0-6	19	—	—
1888	—	—	—	—	—	—	0-2	20	-0-5	18	0-1	23	0-2	16	0-1	19	0-1	27	0-3	15	0-7	13	0-1	11
1889	-0-2	2	—	—	0-2	6	0-1	1	1-1	16	0-8	10	—	—	0-7	7	—	—	0-6	1	0-3	5	—	—
1890	0-0	1	—	—	0-1	7	0-1	29	1-0	27	0-5	3	0-0	9	-0-5	17	0-2	12	0-0	8	-0-4	13	—	—
1891	—	—	—	—	-0-1	24	-0-1	24	0-2	32	0-5	35	0-9	7	0-3	21	0-3	20	0-4	10	0-3	8	—	—
1892	—	—	—	—	-0-3	5	0-2	12	-0-4	15	0-5	19	0-1	9	0-2	14	-0-8	13	0-1	20	-0-4	10	—	—
1893	—	—	—	—	-0-1	6	0-3	15	0-3	17	1-3	15	1-6	7	1-4	29	1-2	20	0-3	10	-0-1	7	0-1	2
1894	-0-1	7	—	—	0-2	9	0-5	8	1-0	28	0-2	8	0-4	7	0-7	7	-0-1	26	0-9	5	—	—	-0-6	1
1895	—	—	—	—	-0-3	4	-0-3	4	0-7	40	0-5	21	0-7	14	1-2	31	0-2	20	0-1	17	0-1	8	-0-5	1

Area G

1876	—	—	—	—	0-8	8	0-4	51	0-8	108	0-2	89	0-2	84	-0-2	43	1-0	24	1-4	11	—	—	—	—
1877	—	—	—	—	—	—	1-0	9	0-8	40	-0-3	38	0-3	11	0-6	10	1-3	17	1-3	1	—	—	—	—
1878	—	—	—	—	—	—	0-2	6	-0-2	34	1-1	36	0-8	27	0-6	18	0-2	6	-1-1	1	—	—	—	—
1879	—	—	—	—	—	—	0-0	6	0-9	14	0-8	18	-1-2	18	1-1	6	0-0	8	—	—	—	—	—	—
1880	—	—	—	—	—	—	2-0	11	1-4	29	1-2	25	2-4	8	1-7	11	1-8	4	-0-2	6	1-2	10	—	—
1881	—	—	—	—	—	—	1-3	21	1-1	50	0-1	35	0-1	37	0-7	17	1-3	23	1-5	9	1-5	4	2-5	2
1882	—	—	—	—	1-3	4	-0-6	75	-0-8	75	-0-8	58	-1-1	34	-1-1	35	-1-1	10	0-1	48	-0-5	29	-0-2	6
1883	1-5	2	-0-2	4	0-4	22	0-5	51	-0-6	51	-1-0	47	-0-6	50	-0-3	28	0-1	40	-0-1	16	0-7	3	1-6	3
1884	-1-1	3	-0-2	2	1-3	6	1-0	32	-0-2	40	-0-4	31	-0-2	25	-0-4	29	0-0	20	0-1	22	0-5	5	-0-2	2
1885	—	—	-0-5	1	0-4	3	-0-7	59	-0-4	78	-1-3	34	-1-3	26	-0-8	34	-0-4	21	-0-2	20	-0-1	9	—	—
1886	—	—	—	—	-0-3	9	0-0	27	-0-8	38	-1-3	44	-1-2	39	-1-5	18	-0-7	47	-0-4	15	-0-2	7	—	—
1887	—	—	—	—	—	—	0-0	12	-1-0	48	-0-5	56	-0-9	30	-1-4	56	-0-7	20	-0-2	34	-0-9	11	-3-2	2
1888	-2-1	1	-2-4	2	-2-6	6	—	—	-1-8	89	-2-0	68	-0-5	44	-0-4	43	-0-4	34	0-2	33	0-7	11	-0-2	5
1889	1-6	2	0-1	11	-0-8	3	0-2	9	1-0	26	0-5	18	0-7	17	0-9	15	0-0	8	1-6	9	0-6	7	0-0	1
1890	1-4	5	-0-1	3	—	—	0-3	43	1-2	28	0-4	15	0-0	23	0-1	32	0-3	12	-0-4	18	0-0	10	—	—
1891	0-4	4	—	—	-1-8	5	0-1	59	0-1	33	0-9	52	1-2	16	0-2	50	0-0	9	0-3	31	0-9	7	—	—
1892	—	—	—	—	-0-6	11	-1-3	30	-0-6	64	-0-4	41	-1-1	47	-1-1	30	-1-1	25	0-3	27	-0-3	13	-3-1	3
1893	—	—	—	—	0-8	7	0-6	22	0-3	73	1-2	43	1-2	38	1-5	47	0-6	8	0-3	20	-0-1	9	1-2	5

Area H	in the Areas H and I (see Fig. 5) during the years 1976-1999.											
	January	February	March	April	May	June	July	August	September	October	November	December
	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
1876	—	—	—	0.0 102	0.5 74	-0.1 51	-0.3 28	-0.3 22	0.2 66	0.7 40	0.9 1	—
1877	—	—	0.3 23	0.3 45	0.1 36	-0.6 20	-0.3 24	-0.3 6	0.5 22	1.2 14	—	—
1878	—	—	-0.2 5	0.6 58	0.2 11	0.7 1	0.2 21	1.1 5	—	0.5 5	—	—
1879	—	—	-0.4 1	0.2 8	0.1 24	0.2 9	-0.3 13	0.1 14	-0.6 1	—	—	—
1880	—	—	-0.1 6	0.2 8	0.1 24	0.2 9	-0.3 13	0.1 14	0.6 10	—	—	—
1881	—	—	—	0.8 58	0.9 30	0.9 17	2.8 5	2.5 27	1.6 10	-0.4 1	0.5 15	—
1882	—	—	—	0.6 47	0.6 56	0.2 32	-0.4 36	-0.1 26	0.4 51	1.0 13	0.8 5	1.4 16
1883	—	—	0.4 31	-0.3 110	-0.5 98	-0.1 62	0.3 33	-0.2 34	-0.5 30	0.3 41	-0.1 19	-0.2 23
1884	-0.3 7	0.2 6	-0.4 15	0.1 107	-0.2 70	-0.1 45	0.2 16	-0.1 16	0.1 53	0.3 25	0.0 15	—
1885	-0.3 5	0.3 6	0.5 9	0.3 75	-0.4 66	-0.6 65	-1.0 21	-0.6 60	0.3 21	-0.2 38	-0.1 9	-0.3 7
1886	0.5 4	-0.5 7	0.1 29	-0.2 100	-0.5 49	-1.1 31	-1.6 47	-0.9 27	-0.4 28	-0.8 25	-0.5 25	0.4 1
1887	—	—	-0.2 14	0.0 71	0.1 44	-0.5 44	-0.6 31	-1.1 54	-0.9 48	-0.4 33	-1.1 17	—
1888	—	-0.2 14	-0.1 22	-0.5 98	-0.2 68	0.1 100	0.0 57	-0.6 12	-0.1 20	-0.3 18	-0.5 10	-0.7 4
1889	-0.7 4	0.5 7	-1.1 11	0.0 8	-0.5 112	0.2 49	-0.2 34	-0.2 81	-0.2 29	-0.1 29	0.4 18	—
1890	-0.1 16	0.2 16	-1.1 11	0.0 53	1.3 36	1.0 78	0.1 19	0.7 18	0.2 17	0.9 14	1.1 10	0.0 11
1891	0.5 7	0.4 8	0.2 27	0.3 68	0.6 98	0.0 69	-0.1 24	-0.1 76	-0.1 33	0.1 12	-0.4 23	-0.2 8
1892	0.6 7	0.4 6	0.0 20	0.0 122	0.1 114	0.3 81	0.5 48	0.0 70	-0.3 34	0.3 26	0.0 15	—
1893	—	-0.7 10	-0.3 11	-0.5 105	-0.6 63	0.2 54	-0.9 35	-0.5 44	-0.7 51	-1.0 35	-0.1 22	-1.0 6
1894	-0.3 7	-1.4 7	0.3 20	0.2 106	0.3 68	0.1 67	0.5 32	0.4 20	0.2 11	0.0 33	1.0 10	0.5 6
1895	0.2 6	-0.1 8	-0.4 8	0.0 72	0.5 156	0.4 115	0.7 85	0.3 76	-0.2 28	-0.6 13	-0.1 18	0.6 6

Area I

	January	February	March	April	May	June	July	August	September	October	November	December
	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ
1876	—	—	0.6 2	-0.4 13	-1.9 8	-0.4 34	0.2 10	0.4 39	0.0 9	1.9 2	0.0 4	—
1877	—	—	—	-0.3 9	0.2 14	1.0 28	-0.3 27	0.1 21	0.4 16	0.3 6	—	—
1878	—	—	-0.4 1	—	-0.7 16	0.4 19	0.5 12	1.4 18	0.9 13	-1.8 7	—	—
1879	—	—	—	0.3 5	0.8 7	0.5 6	-1.4 10	0.2 24	-0.1 15	2.3 1	—	—
1880	—	—	—	0.1 7	1.3 63	2.2 18	2.4 36	2.4 19	1.1 30	-0.1 12	-1.4 2	—
1881	—	—	—	-1.6 10	-0.4 20	0.3 34	-0.2 36	-0.2 17	0.1 24	0.0 26	—	2.4 2
1882	—	—	0.1 13	0.3 59	-0.6 33	-1.2 43	-2.2 41	-1.6 18	-2.7 25	-1.1 42	-0.6 22	-0.8 1
1883	—	-0.4 2	0.2 6	1.0 65	0.4 74	0.0 75	0.3 68	-0.2 36	0.6 58	0.4 45	-0.1 9	—
1884	0.0 2	0.0 2	0.3 15	1.5 63	0.5 104	0.0 73	0.3 83	0.9 53	1.2 37	0.5 58	0.4 22	—
1885	-0.1 3	-1.4 2	1.5 6	-0.3 79	-0.2 99	-1.1 46	-0.6 46	-0.5 71	0.3 65	-0.7 49	0.2 19	—
1886	—	-0.2 9	-0.7 7	-0.7 55	-1.2 78	-0.8 30	-1.6 42	-1.8 48	-0.8 39	-0.2 28	0.0 9	—
1887	—	0.0 4	0.1 14	-0.5 40	-0.2 50	-1.5 34	-2.8 47	-2.8 54	-2.7 50	-2.7 32	-2.1 18	-1.7 4
1888	-1.2 2	—	-0.2 5	-0.2 3	-1.3 74	-2.5 31	-1.3 27	-2.3 36	-0.8 29	-2.0 24	-0.9 5	—
1889	—	0.3 3	-0.2 4	-0.6 26	1.1 47	0.8 11	1.2 30	1.8 26	1.9 27	1.2 26	1.4 3	—
1890	0.8 1	—	0.7 9	1.2 45	1.2 43	0.9 45	0.4 17	-0.1 42	0.0 18	-0.4 18	-0.8 6	—
1891	—	—	0.2 3	-0.7 75	-0.2 55	-0.2 72	-0.2 33	0.4 49	-0.3 25	0.3 39	0.3 24	—
1892	—	0.0 4	-0.2 4	-1.1 27	-1.8 72	-2.9 50	-1.5 54	-1.7 51	-1.5 53	-1.4 38	-0.3 11	-1.8 2
1893	—	—	0.7 2	0.7 13	0.3 74	1.0 50	0.5 63	0.4 30	-0.1 14	0.1 13	-0.1 6	1.7 1
1894	—	—	0.0 4	0.3 50	0.5 21	0.4 95	2.0 43	1.8 50	2.0 18	1.8 34	1.8 7	—
1895	1.2 2	0.7 1	-0.1 3	-0.7 84	-0.1 113	0.4 91	0.4 99	0.5 79	0.0 72	-0.4 34	0.3 9	—

Table 3.

Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Area H
(see Fig. 5) during the Years 1896—1939. (1876—1895 see preceding page).

	January		February		March		April		May		June		July		August		September		October		November		December	
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n
1896	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1897	0.0	1	-0.1	7	0.3	42	0.3	64	0.0	56	-0.3	131	-0.1	72	0.0	36	-0.1	39	-0.7	30	-0.7	21	-0.1	11
1898	0.5	8	-0.1	6	-0.3	30	-0.1	90	-0.1	77	-0.2	50	-0.1	94	0.7	76	-0.3	32	-0.2	17	0.1	12	-0.3	6
1899	-0.6	5	-0.3	9	-0.3	33	-0.5	104	0.1	62	0.4	89	0.5	72	-0.3	72	-0.5	30	0.4	57	-0.6	18	-1.4	9
1900	0.2	7	-0.2	10	-0.1	16	-0.3	71	0.2	63	0.5	86	1.5	67	1.1	60	0.5	60	-0.4	57	-0.3	35	0.2	23
1901	-0.3	9	0.1	15	0.1	50	0.0	81	0.3	74	0.3	72	-0.1	55	-0.3	45	0.2	60	-0.2	24	0.1	32	—	—
1902	-1.1	4	0.1	21	-0.5	38	0.2	101	-0.2	99	-0.6	98	0.4	38	-0.3	84	0.3	52	0.6	21	0.4	23	1.3	4
1903	0.1	5	-0.3	4	-0.1	22	-0.3	81	-0.3	48	-0.3	67	0.4	50	-0.1	48	-0.2	17	0.0	15	0.4	23	0.1	17
1904	—	—	—	—	0.2	50	-0.4	83	-0.2	51	0.1	79	0.5	78	1.0	64	0.3	33	-0.4	47	-0.2	32	0.0	20
1905	0.2	20	0.0	8	0.0	29	-0.2	52	-0.3	55	0.2	54	0.4	61	0.1	65	-0.2	31	0.1	27	0.2	37	-0.2	14
1906	0.2	16	-0.4	33	-0.3	45	-0.2	90	-1.0	53	-0.5	47	-0.6	105	-0.4	28	0.0	62	0.0	26	0.2	35	-0.1	10
1907	-0.1	17	0.2	23	-0.4	47	-0.3	62	-0.3	60	-0.8	50	0.1	65	-1.3	60	-0.8	60	-0.3	30	-0.7	48	-0.1	9
1908	0.2	8	0.2	6	-0.1	26	-0.1	26	-0.1	56	-0.5	58	-0.1	55	-0.2	44	-0.4	61	0.4	53	1.0	27	1.0	14
1909	-0.5	15	-1.2	8	-0.2	22	0.1	81	-0.2	38	0.6	72	0.1	91	0.1	57	0.0	74	0.0	37	0.1	38	—	—
1910	-0.3	10	-0.6	22	0.0	25	-0.6	102	-0.2	57	-0.2	60	0.0	67	0.2	73	0.1	62	0.0	58	-0.7	26	0.5	8
1911	0.1	9	0.0	16	0.0	38	-0.2	56	0.3	73	0.0	41	-0.5	49	-0.1	27	-0.2	78	-0.5	30	-0.1	13	—	—
1912	-0.1	11	-0.4	25	0.0	32	-0.1	17	-0.2	47	0.3	101	-0.3	84	-1.4	116	-0.2	53	-0.2	41	0.2	48	0.2	7
1913	0.7	6	0.2	12	-0.2	62	-0.2	128	-0.3	116	-0.3	117	0.0	103	-0.1	89	-0.6	101	0.1	91	-0.1	67	-0.7	6
1914	—	—	-0.9	11	-0.1	38	-0.2	94	-1.0	66	-0.7	73	-0.6	136	-0.8	110	-0.5	49	-0.7	100	0.0	62	-0.4	11
1915	-0.1	7	-0.2	17	-0.4	36	-0.5	42	-0.1	82	0.5	52	0.2	59	0.3	124	0.4	82	1.0	54	0.3	32	-0.4	4
1916	-1.2	5	-0.3	11	-0.8	49	-0.3	53	-0.3	116	-0.1	97	0.0	57	0.1	73	0.1	82	-0.2	95	-0.5	48	-2.8	5
1917	-0.2	13	—	—	-0.9	7	-0.5	48	-0.2	136	-0.7	84	1.2	83	0.7	44	0.1	63	-1.8	30	-0.5	31	0.2	15
1918	1.6	5	-0.1	18	-0.6	34	0.1	43	0.8	100	-0.2	93	-1.3	46	-0.4	75	-1.8	86	0.1	63	-0.1	34	0.4	21
1919	-0.9	6	-0.5	5	-0.5	8	-0.6	43	0.4	55	0.4	52	0.6	52	-0.3	64	-0.4	63	-1.6	61	-0.7	55	-1.8	17
1920	-0.8	37	-1.9	9	-0.4	21	-2.0	12	0.4	22	0.4	55	0.2	110	-0.7	116	-0.5	79	0.5	97	-0.7	23	0.5	20
1921	—	—	-0.1	16	-0.3	26	-0.6	78	-0.8	56	-0.6	57	-0.3	77	-1.2	54	-0.8	79	-0.5	62	-0.4	51	0.2	3
1922	-0.6	7	-0.8	7	-0.4	6	-1.0	50	-0.3	20	-1.0	62	-1.3	65	-1.0	50	-0.9	81	-0.7	51	-0.3	30	0.3	13
1923	0.0	20	0.9	19	0.3	15	0.0	78	-0.3	53	-0.5	89	-0.5	86	-0.6	76	-1.1	103	-1.1	77	-1.4	30	—	—
1924	0.3	25	0.4	30	-0.4	31	-0.8	24	-0.3	59	-0.7	57	-0.1	115	0.1	92	-0.6	68	-0.4	57	-0.6	38	0.3	17
1925	0.2	25	-0.3	34	-0.2	37	-0.1	88	-0.1	86	0.0	121	-0.1	88	-0.1	123	-0.7	54	-0.4	59	-0.4	34	0.4	26
1926	0.4	21	1.0	30	0.1	23	0.5	81	0.2	80	0.0	77	1.0	132	0.6	73	-0.2	92	-0.4	66	-0.5	47	-0.1	42
1927	-0.4	20	0.4	24	0.4	17	0.0	40	0.2	57	0.1	49	0.5	68	0.2	46	0.1	35	0.1	43	-0.3	54	0.0	30
1928	0.2	43	0.4	36	0.3	48	0.5	59	0.7	120	0.1	64	-0.5	92	-0.3	120	0.2	87	0.4	60	0.5	62	0.2	56
1929	0.4	21	0.8	41	0.8	36	0.4	78	0.7	78	0.6	67	0.0	17	0.2	105	-0.2	103	-0.7	70	-0.5	57	0.2	33
1930	0.1	19	0.2	27	-0.3	44	0.1	85	0.4	84	0.1	100	-0.2	107	-0.4	93	0.4	112	-0.1	103	-0.3	67	-0.2	19
1931	-0.4	19	-0.5	24	-0.1	54	-0.4	95	0.1	63	-0.5	77	-0.5	57	0.1	80	0.2	78	0.0	76	0.3	38	0.3	27
1932	0.1	19	0.8	29	0.9	65	-0.3	78	0.4	100	1.3	99	0.8	92	0.4	85	-0.1	82	-0.2	95	0.4	64	0.7	17
1933	0.8	32	0.5	33	0.6	42	0.5	64	0.8	115	0.1	72	1.2	73	0.5	73	1.2	120	0.5	78	0.3	62	0.7	29
1934	0.8	28	0.8	38	0.2	58	0.2	79	0.0	89	0.1	85	0.8	78	0.7	73	0.7	105	0.0	87	-0.1	69	1.0	13
1935	0.8	21	0.0	24	0.5	58	0.1	70	1.2	78	-0.1	58	0.1	75	0.4	61	0.6	66	-0.1	66	0.5	33	0.5	44
1936	0.3	17	0.4	30	0.6	58	0.7	77	0.5	109	0.3	103	0.7	85	0.8	83	0.8	99	1.0	75	0.4	51	0.0	15
1937	0.2	20	0.4	30	0.6	58	0.7	77	0.5	109	0.3	103	0.7	85	0.8	83	0.8	99	1.0	75	0.4	51	0.0	15

	January		February		March		April		May		June		July		August		September		October		November		December	
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n
1896	—	—	—	—	-0.2	14	-0.8	93	0.4	106	-0.9	49	-0.3	123	-0.5	76	0.0	48	-1.6	22	-0.6	19	-2.1	1
1897	-0.3	5	—	—	-0.6	10	1.1	58	0.4	75	-0.1	67	-0.9	78	0.2	38	-0.3	74	-0.3	22	—	—	-0.8	1
1898	—	—	—	—	0.3	6	0.3	85	0.3	109	-0.1	128	0.1	77	0.1	78	-0.1	60	0.7	25	0.8	17	-0.2	2
1899	0.2	3	—	—	-0.3	34	-0.2	71	0.4	103	1.2	120	0.8	79	1.2	124	1.1	76	0.4	62	0.5	25	0.5	25
1900	0.4	2	—	—	-0.3	26	0.1	78	0.0	105	0.9	115	0.3	105	0.8	128	0.9	72	0.0	66	0.9	12	0.6	10
1901	-0.9	1	0.6	9	-0.6	28	0.2	128	1.0	97	-0.3	72	0.7	100	0.5	88	1.0	68	0.5	44	1.1	15	—	—
1902	0.2	3	0.4	5	-1.2	41	-1.0	116	-1.2	82	-1.2	82	-0.9	74	-0.9	88	-0.3	97	0.6	42	0.7	24	2.0	2
1903	-0.2	3	0.4	3	-0.2	10	-0.3	52	-0.3	94	-0.3	105	-0.1	95	-1.1	94	-0.5	75	0.2	54	0.5	22	1.0	4
1904	—	—	—	—	0.1	40	0.3	71	0.2	77	1.5	85	0.9	87	0.9	96	1.3	81	0.4	35	-0.4	23	-0.4	6
1905	0.3	7	-0.9	1	-0.3	43	0.0	65	0.3	85	1.1	65	1.1	71	0.6	70	-0.3	64	0.0	29	-0.4	14	-0.1	25
1906	0.6	8	0.0	31	-0.1	15	1.1	27	-1.0	102	0.3	68	-0.8	47	-1.4	75	-0.6	58	-0.1	43	-0.2	21	-0.2	11
1907	—	—	-0.9	16	-1.4	58	-0.5	71	-0.3	60	-1.3	65	-1.0	37	-1.4	70	-0.9	55	-1.0	41	-0.4	18	0.4	16
1908	-0.6	2	-0.8	12	0.1	23	-0.1	28	-0.3	42	-0.5	29	1.6	55	0.2	58	0.6	48	0.9	18	0.9	31	0.9	15
1909	-0.6	5	0.8	6	-0.5	9	0.8	43	0.6	48	2.3	54	1.2	48	0.8	52	0.8	55	0.1	20	0.5	14	-0.5	20
1910	-1.7	5	0.3	15	-0.3	24	-0.5	22	-0.4	28	-0.5	45	-0.1	37	0.9	30	1.0	33	1.1	27	0.2	19	1.2	9
1911	-0.5	8	-0.3	14	-0.7	19	-0.8	14	-0.6	68	-0.7	37	0.0	56	0.1	40	-1.2	18	-0.4	32	0.9	1	0.7	19
1912	0.1	21	0.2	70	0.2	51	0.3	17	1.4	89	0.9	105	1.6	60	-0.2	64	0.3	32	0.3	86	-1.0	24	-0.7	25
1913	0.2	19	0.7	47	-0.4	12	-0.4	25	0.7	99	0.0	27	1.6	139	0.9	205	1.7	94	0.2	86	-0.5	16	-0.5	29
1914	0.6	5	-1.0	10	-0.5	18	-0.4	24	0.1	36	-0.6	15	-0.4	15	0.2	17	-0.1	33	-0.4	14	-0.2	16	0.2	7
1915	-0.1	5	-0.6	18	-0.4	12	-0.6	8	-0.1	23	0.0	17	-1.4	31	-0.9	7	-0.8	39	1.4	17	0.2	9	-0.9	19
1916	-0.6	22	-0.6	2	0.0	16	2.0	3	0.2	20	0.7	10	1.1	43	1.3	24	0.4	27	0.2	9	-0.5	16	-1.5	24
1917	0.3	3	—	—	—	—	-0.8	13	0.0	3	0.9	13	1.1	23	-1.8	3	1.4	16	—	—	—	—	-1.0	8
1918	0.9	1	0.8	15	-0.4	6	0.0	12	1.3	14	0.3	39	-1.4	51	-0.8	23	-0.9	38	0.0	6	0.4	5	0.7	1
1919	-1.7	3	1.0	2	—	—	-0.7	9	0.4	8	0.9	35	0.8	23	0.7	8	-1.5	2	-0.2	2	-0.7	10	-0.7	22
1920	-0.6	7	-1.2	1	-2.2	8	-0.5	2	-1.2	13	0.0	27	0.6	43	0.6	66	0.6	23	2.1	13	0.9	21	0.7	15
1921	-0.6	4	0.2	12	-0.9	14	-1.6	24	-1.0	19	-0.7	19	-1.0	6	-1.5	9	-1.1	42	-1.6	12	-0.3	17	—	—
1922	-0.4	19	-0.8	7	-1.1	19	-1.1	31	-0.8	14	-0.4	24	-1.0	22	0.6	26	0.3	36	0.9	30	-0.3	32	0.4	11
1923	-2.1	15	1.5	12	1.0	26	1.1	33	0.8	29	-0.4	22	-0.4	8	0.3	19	-0.4	32	0.3	25	-0.2	9	-1.0	8
1924	0.4	6	1.3	3	-1.5	23	-0.6	23	0.5	38	0.2	19	0.3	41	0.4	36	-0.5	9	-0.3	33	0.4	11	0.8	16
1925	0.1	6	0.2	11	-0.3	28	0.5	36	0.1	45	0.4	8	-0.2	10	0.3	9	0.4	24	-0.3	36	0.0	12	0.2	10
1926	-0.1	16	0.5	13	-0.6	10	0.7	27	0.7	34	0.9	47	1.7	35	0.4	34	0.8	26	-1.4	32	0.0	12	0.4	13
1927	-0.6	5	1.2	30	-0.3	33	-0.6	34	1.6	22	0.7	29	1.8	19	1.1	32	0.6	28	1.1	29	0.3	22	1.2	27
1928	0.0	9	0.5	17	0.9	29	1.7	18	1.1	39	0.8	59	0.4	35	0.6	52	1.5	28	1.4	24	1.3	23	1.4	16
1929	0.8	11	1.9	24	1.4	51	0.6	44	1.3	37	1.2	32	1.1	20	0.8	70	0.7	43	-0.3	43	0.2	48	0.7	21
1930	-0.2	10	1.1	21	-0.1	30	0.2	26	1.2	58	0.8	30	0.5	55	0.3	45	0.9	35	0.0	42	-0.8	31	0.1	7
1931	-0.7	12	0.3	33	-0.6	22	0.2	39	0.8	31	-0.3	34	0.2	65	0.8	67	1.2	35	0.7	39	1.2	23	1.1	18
1932	-0.2	13	1.7	25	1.0	32	-0.1	22	0.9	28	1.9	65	0.3	50	0.6	40	0.3	40	0.2	33	0.6	19	0.8	24
1933	1.0	13	0.2	17	0.2	20	1.0	21	1.5	22	1.5	56	1.8	29	1.5	58	2.1	28	0.6	38	0.2	17	1.6	12
1934	0.4	13	0.0	10	0.9	26	0.7	32	0.9	73	1.2	45	1.9	38	1.6	30	1.5	29	1.5	35	0.0	24	1.1	13
1935	0.4	7	0.0	15	0.6	17	0.0	16	2.2	45	1.0	35	0.6	32	1.1	37	1.5	41	0.9	17	1.3	23	1.5	18
1936	0.6	12	0.2	14	1.0	22	1.3	10	1.6	20	1.2	20	1.3	31	1.9	28	1.8	30	1.6	24	1.0	16	0.3	15
1937	0.4	7	0.9	3	0.4	9	0.7	13	1.1	15	-0.5	9	0.9	16	1.4	19	0.9	29	0.7	12	0.7	14	0.9	7
1938	0.8	15	1.2	8	0.7	22	1.3	11	-0.1	15	-1.0	6	-0.5	67	0.5	20	1.2	24	1.1	13	1.0	9	1.8	10
1939	0.2	13	0.4	12	0.9	13	1.4	24	1.5	16	2.1	19	0.9	55	1.9	33	2.2	10	0.8	6	0.2	4	0.9	9

Table 5.
Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of
the Surface Temperature in the Areas F, G, H and I (see Fig. 5)
for the Period July 1945—December 1947.

	Area	F		G		H		I	
		Δ	n	Δ	n	Δ	n	Δ	n
July	1945	0.5	39	—	—	0.3	39	2.1	10
August	"	1.2	14	-3.4	2	1.6	15	1.1	1
September	"	0.4	17	2.0	18	1.6	37	—	—
October	"	0.8	19	1.4	2	1.5	27	—	—
November	"	1.4	18	3.7	1	2.1	25	2.5	3
December	"	0.3	7	2.1	4	0.4	31	2.2	3
January	1946	0.0	2	2.5	4	1.6	20	1.4	3
February	"	—	—	—	—	1.0	11	1.3	7
March	"	—	—	1.7	5	1.3	22	1.6	10
April	"	0.3	54	0.2	2	0.6	113	1.3	5
May	"	1.4	62	1.4	10	1.7	90	1.7	14
June	"	1.9	22	1.4	10	0.6	53	1.3	7
July	"	0.4	31	-1.3	23	0.6	71	1.3	11
August	"	0.3	10	0.4	5	1.2	27	1.8	6
September	"	-0.4	40	0.8	27	0.8	72	2.0	11
October	"	1.2	59	0.8	11	1.2	94	1.6	7
November	"	1.8	10	2.8	8	1.6	45	2.0	10
December	"	0.4	16	1.7	17	1.3	59	2.7	5
January	1947	1.6	2	2.1	18	1.3	52	1.7	7
February	"	—	—	—	—	1.1	20	1.5	13
March	"	0.0	25	0.6	2	0.6	46	0.7	14
April	"	-0.3	49	1.0	1	0.3	75	1.2	2
May	"	1.0	28	1.1	3	1.0	55	1.2	7
June	"	0.7	41	-0.3	2	0.5	64	0.7	11
July	"	0.2	25	-0.5	5	0.2	55	0.8	49
August	"	-0.1	29	0.4	26	0.8	69	1.3	12
September	"	0.2	25	-0.4	27	0.5	55	2.0	11
October	"	0.3	14	-0.6	12	0.5	42	0.6	12
November	"	-0.4	30	1.7	5	0.5	91	1.3	6
December	"	0.2	19	1.2	3	0.7	41	1.5	7

based on incomplete series of data. This applies especially to Grímsey where ice conditions sometimes render observations impossible. The anomalies based on such incomplete data have in Figs. 8 and 9 been distinguished by dotting the lines from the point in question to the neighbouring points. In these figures as well as in Figs. 6 and 7 dotted lines are also used in connecting points where intermediate points are missing.

It appears from Figs. 8 and 9 that from about 1920 there is a very marked predominance of positive anomalies at the stations Vestmannaeyjar, Grímsey and Papey while the positive anomalies are not predominant to the same degree at Stykkishólmur.

In conclusion I should like to thank Mrs. Poula Holm and Mr. P. Alnøe who have made out the calculations.

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 Vedráttan 1924—1942. Reykjavik.

Jens Smed

points. Decapod larvae, were abundant, including mainly larvae of *Eupagurus*, *Pandalus*, *Munida*, *Galathea*, *Corystes* and *Portunus*. A dense patch of mixed *Chaetoceros borealis* and *Ch. decipiens* was found north-east of Faroe, and in this area *Oikopleura vanhoeffeni*, and nauplii of *Balanus* sp. were also common.

J. H. Fraser.

Calanus and Herring at NE. Iceland.

Some preliminary experiments on the use of pumps in detecting the *Calanus* swarms found during the summer herring season in 1947, were carried out with the deck pump of the patrol boat "Ægir".

The results of one of the pump series are shown in the accompanying diagram. The quantity of *Calanus* pumped through silk No. 3 per hour is shown in the diagram. The quantity was measured by water displacement, in ml. (Fig. 11).

It will be seen that at this time (20.30 hrs. on 27/7/47 to 19.15 hrs. on 28/7/47) there was a high maximum of *Calanus* off Vopnafjörður and Bakkaflói, and another on the Grimsey grounds and off Siglufjörður. The former maximum in partic-

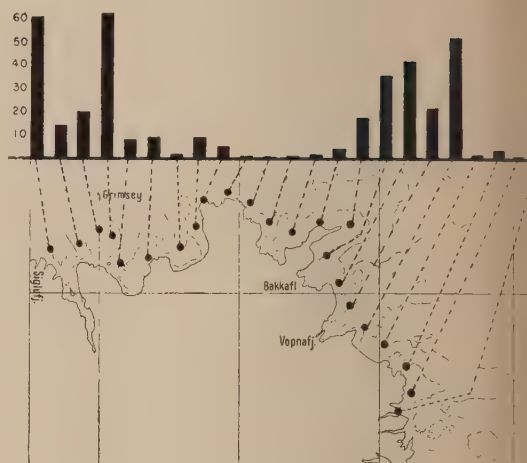


Fig. 11. Density of *Calanus* (see text).

ular, corresponds exactly with the herring shoals being caught at that time by the Icelandic fleet as shown by the catch records of the week 20th to 26th July.

Hermann Einarsson

THE FISH.

Eggs and Larvae.

Occurrence of 0-Group Cod, Haddock and Coalfish during the Summer, 1947.

In the beginning of June 1947 the "Dana" made a survey of the pelagic stages of cod, haddock and coalfish in the Faroe area (Table 6 and Fig. 12). The material was collected with the 2-m. stramin net by 30-minute oblique hauls. In each of the 5 hauls carried out over depths of between 50 and 200 m., the numbers of cod and haddock larvae were extremely high compared with investigations in previous years. The averages calculated per hour, 902 cod and 708 haddock, were much higher than ever observed before in this area. In the years 1924—39 the highest average number per hour, 226 cod and 357 haddock larvae, was found on the 21st to 23rd June, 1932 (Fig. 13). While the number of pelagic cod and haddock fry may have been near their maximum at this time of the year, the larger part of the 0-group coalfish had left the pelagic stage. The average number of pelagic coalfish larvae was 72, which is somewhat higher than previously found in June (Fig. 13).

On the 11th and 12th June the *eel hand-seine*

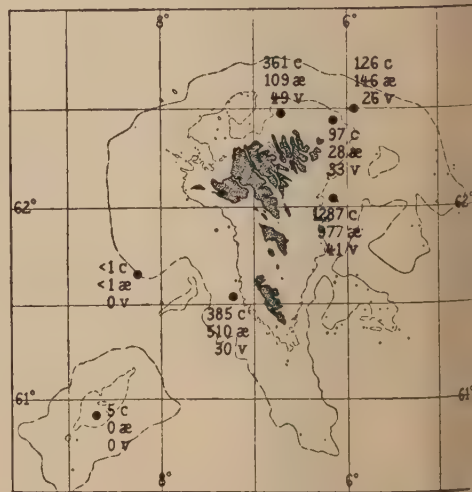


Fig. 12. Larval stages of cod (c), haddock (æ) and coalfish (v). Number of specimens per ½ hour haul with 2 m. stramin net. 7th—10th June, 1947.

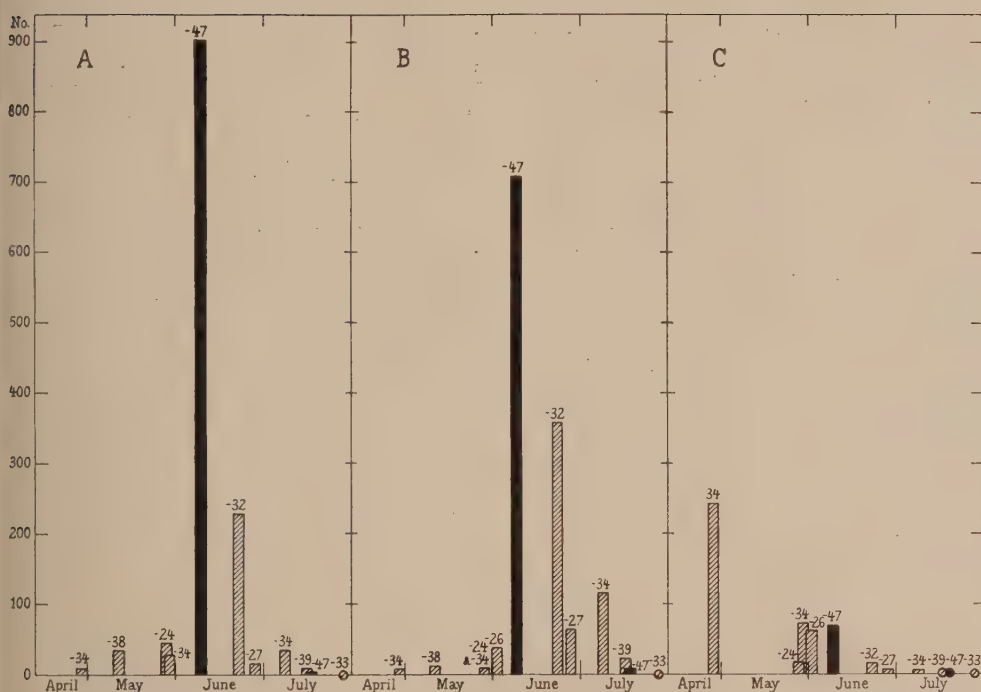


Fig. 13. Average numbers of larval cod (A), haddock (B) and coalfish (C) per one hour haul with 2 m. stramin net. 1947 (black) compared with investigations 1924 to 1939 (hatched). 0: no specimens caught.

The columns are related to the central date of each survey.

used in the littoral zone in two fjords. The up cod had not yet invaded the littoral zone as m stage fish. At Vaag the average number of up coalfish per haul was 37, somewhat below

the average for June for all previous investigations, but the 4 hauls carried out in Klaksvig yielded on an average about 3,600 per haul. The highest average number of 0-group coalfish per haul pre-

Table 6.
Larval Cod, Haddock and Coalfish.

Total Catch in 5 hauls¹⁾ in depths of between 50 and 200 m. 7th—10th June, 1947.
(Positions in Fig. 12).

		Length in millimetres															
		5	6	7	8	9	10	11	12	13	14	15	16	17	18		
lock fish		—	—	5	25	61	98	81	122	100	81	72	44	34	14		
		3	6	32	114	187	189	123	59	21	30	22	11	8	8		
		—	—	—	2	12	28	31	27	19	17	16	14	1	3		
		Length in millimetres									No. mea- sured	Total No.	No. per hour	Av. Size ⁴⁾ in mm.			
		19	20	21	22	23	24	25	26	27							
lock fish		20	7	3	3	—	1	—	1	1	773	2,256 ²⁾	902	13.30			
		9	4	3	1	—	1	1	1	—	833	1,770 ³⁾	708	10.91			
		3	2	1	1	1	—	1	—	—	179	179	72	13.22			

¹⁾ Oblique hauls at 3×10 minutes; net towed about 10 minutes in each of the depths corresponding to either 150, and 50 or 100, 50 and 25 m. of wire out.

²⁾ 1,483 not measured.

³⁾ 937 not measured.

⁴⁾ Corrected by +0.5.

viously found in a single locality at the Faroes in June is 407 (Fuglefjord 23/6/32) and later in the summer 1367 (Vaag 10/8/12). The average number per haul for all collections from 1903 to 1939 is barely 300 in the latter half of July, when normally the number per haul reaches its maximum.

In the middle of July 1947 the "Dana" made a second survey in the area. Very few pelagic cod and haddock (about 2 per hour-haul) and no coalfish were caught in the stramin nets. In 8 hauls with the eel hand-seine, 4 in Fuglefjord and 4 at Klaksvig, on an average 14 0-group cod were caught per haul. Usually hardly any bottom stages of 0-group cod are found in the Faroe fjords before August; the average for all investigations made in July from 1903 to 1939 is only 0.3 per haul. In both fjords 0-group coalfish were numerous; on an average about 1100 were caught per haul, i. e., an average much higher than that for 1903—1939, which is barely 300.

The fact, that the fry of all three species was more numerous in 1947 than ever observed before in the Faroe area, can hardly be explained as due solely to especially favourable conditions for the fry this year.

The fishery statistics for 1940—45 show that in this area the fishery was reduced to about 25 % of the pre-war intensity, while the total catch of all species per trawling hour increased by more than 100 %. The quantity of the 3 species here considered, landed per 100 hours fishing from Faroe grounds by British steam trawlers in 1946, given as a percentage of the averages for the last 10 pre-war years (1929—38) were the following:— cod: 228 %, haddock: 317 % and coalfish: 160 %.

The spawning stock of these fish has thus increased considerably, and the striking abundance

of fry indicates that, in this small and restricted area, the number of eggs spawned is of more importance to the recruitment of the stock than was previously supposed.

E. Bertelsen.

Haddock.

The Stock in Faroese Waters in 1947.

A limited survey of the fish stocks in Faroese waters was conducted by the Scottish research vessel "Explorer" in June 1947, when twelve hauls, each of one hour duration, were carried out with the covered trawl at scattered points around the island.

The age analysis of the haddock caught during the survey is summarised in Table 7. This gives the actual numbers of each brood in each area together with the average catch per 10 hours, and percentage age composition for the whole region.

The figures show that the Faroese stock, like the North Sea one, was comprised mainly of fish in their second, third and fourth years of life. These broods together made up approximately 70 per cent. of the total catch. Fish older than 4 years were present in very small numbers, and appeared only spasmodically throughout the area.

The 1945 brood, was the most abundant brood and alone contributed approximately 60 per cent. to the total catch. Its abundance to the west was generally greater than to the east of the island. The 1946 year-class, was present in greater numerical strength than in the North Sea, and was the second most abundant brood, and again appeared in greater density to the west of the region. At the time of sampling no members of the 1947 brood were taken by the trawl. This cannot be taken

Table 7.
Frequencies of each Age-Group of Haddock and Average Number per 10 hours on Faroese Grounds in June 1947.

Area	1+	2+	3+	4+	5+	6+	7+	8+ and older	Total Fish
Nolsö XX. 23 d	2	67	20	—	—	—	1	3	93
Svinö XX. 23 d	18	167	7	—	—	—	—	—	192
Fuglö YY. 23 a	45	106	5	1	—	—	—	—	157
Enniberg XX. 24 c	5	13	3	1	—	—	—	1	23
Myling WW. 23 b	26	14	29	2	—	—	4	1	76
Myggenæs WW. 23 a	3	20	44	3	1	—	—	2	73
Vaagö WW. 22 b	75	102	14	1	—	2	1	1	196
Sandö-West WW. 22 c	64	103	19	5	—	2	—	2	195
Suderö-West WW. 22 c	55	109	52	7	—	1	—	—	224
Sandö-East XX. 22 b	4	43	7	2	1	1	—	—	58
Monk Rock XX. 21 a	1	63	14	2	—	—	—	1	81
Faroe Bank VV. 20 b	6	16	6	1	1	2	—	4	36
Average No. per 10 hours	253	686	183	20	3	7	5	13	1170
% Age Composition	21.6	58.7	15.7	1.7	0.2	0.6	0.4	1.1	

Table 8.
Number per 10 hours and Percentage of
Haddock in 5-cm. groups from Faroese
Grounds during 1947.

Age in years	Number of Fish	% of Total	Size range in cm.	Number of Fish	% of Total
14	13	1.1	45—49	32	2.7
19	202	17.3	50—54	10	0.9
24	96	8.2	55—59	7	0.6
29	441	37.8	60—64	8	0.7
34	185	15.9	65—69	6	0.5
39	82	6.9	70—74	5	0.4
44	82	6.9	75—79	1	0.1

te a very poor brood survival, however, since spawning may have delayed the growth of the fish.

he size composition of the total catch is summarized in Table 8 which gives the numbers per hours in five-centimetre groups.

aks in the size distribution are shown at approximately 18 cm. and 27 cm., which refer to the sizes of the 1+ and 2+ age-groups respectively. Median was at 28 cm. and the upper quartile 35 cm., revealing a population of small and medium sized fish with relatively few of the large extra large size categories.

he mean sizes for the age-groups in each haul presented in Table 9.

he average size of haddock of the same age is greater to the south and west than to the north east of the regions, and in all but the 1946 brood, each age-group had a greater average size in the main body of the North Sea in June. The greatest growth was found amongst the haddock on Faroe Bank, where, after its second year, growth was significantly greater than in the other regions. The sample from this area was, however, small compared with most of the other samples. At the time of sampling in June, all Faroe haddock were showing new growth on the

scales which is in contrast to the main body of the Faroe and North Sea stocks. Over the entire region, but more especially to the south and west, the 1945 brood had reached marketable size, and therefore suffered commercial exploitation at an earlier date than the same brood in the main body of the North Sea.

B. B. Parrish.

Lemon Soles. Faroe 1947.

Measurements and scale samples of lemon soles were obtained from three sources during 1947 — from the "Explorer" in June, from the "Dana" in June and July and from twenty-four trawler catches landed at Aberdeen fish market throughout the year. The research vessels operated all round the islands including Faroe Bank, while the trawlers worked mainly on northern grounds from SW. of Myggenæs to S. by E. of Nolsö. The size composition of the catches is given in Table 10.

The research vessel records include fish retained by the small mesh but a rather larger than usual catch of small lemon soles by the "Dana" on Faroe Bank has been omitted. The trawler records when compared with the corresponding figures for 1946 show a slight increase in the proportions of small fish and a decrease in the larger sizes.

The age composition of the "Explorer" and trawler catches are given in Table 11 — the greater part of the "Dana" catch was utilized for marking experiments and is, accordingly, not available for age analysis.

These records show that four broods, 1941, 1939, 1937 and 1936, out of the eighteen represented in the catches, provided from 60 to 70 % of the total number of lemon soles caught on Faroese grounds. As these broods were mainly represented by medium or large-sized fish it is reasonable to assume that the percentage of the total weight contributed by them was greater than 70 %. The 1940 and 1942 broods were poorly represented

Table 9.

Mean Sizes of Age-Groups of Haddock from each Region in cm.

Area	Age:	1+	2+	3+	4+	5+	6+	7+	8+	9+
Nolsö		14.0	27.0	35.5	—	—	—	66.0	60.3	—
Svinö		16.4	26.5	36.5	—	—	—	—	—	—
Fuglö		15.7	25.5	34.6	48.0	—	—	—	—	—
Enniberg		18.2	27.1	38.3	47.0	—	—	—	63.0	—
Myling		21.4	31.8	40.2	49.0	—	—	60.0	65.0	—
Myggenæs		21.3	32.0	40.9	48.0	49.0	—	—	65.0	70.0
Vaagö		17.3	28.8	40.2	46.0	—	57.0	60.0	59.0	—
Sandö-West		16.9	28.7	41.4	50.0	—	62.0	—	63.0	72.0
Suderö-West		16.3	28.4	39.5	48.3	—	61.0	—	—	—
Sandö-East		15.7	28.0	37.4	50.0	51.0	55.0	—	—	—
Monk Rock		19.0	29.8	39.6	49.0	—	—	—	64.0	—
Faroe Bank		22.5	39.5	46.1	56.0	67.0	68.0	—	73.0	74.0

Table 10.
Size Composition of Lemon Sole Catches, Faroe 1947.

Length cm.	Explorer		Dana (Offshore)		Dana (Fjords)		Trawlers (Jan.—June)		Trawlers (July—Dec.)	
	No.	%	No.	%	No.	%	No.	%	No.	%
<21	13	6.0	19	8.0	6	5.2	—	—	—	—
21—25	19	8.8	42	17.7	19	16.5	57	4.4	65	5.8
26—30	27	12.5	56	23.5	50	43.5	289	22.6	285	25.3
31—35	94	43.3	71	29.8	26	22.6	549	42.8	495	43.9
36—40	60	27.6	48	20.2	14	12.2	330	25.8	231	20.5
41 and +	4	1.8	2	0.8	—	—	56	4.4	51	4.5
Total	217	100	238	100	115	100	1281	100	1127	100

in both research and commercial figures and must be regarded as contributing comparatively few fish to the stocks. No estimate can yet be made of the addition to the stocks by the three youngest broods but it is interesting to note the capture of three specimens of the 1946 brood — two by the "Dana" on Nolsö and north coast grounds and one by the "Explorer" in the vicinity of the Monk Rock grounds.

The age analysis of the commercial catches also shows that during the latter half of the year the 1943 brood began to be caught in larger numbers than during the first six months. This indicates good survival for that year-class which should be well represented in the catches during the current and succeeding years. It should also be noted that

the percentage of each brood over five years age shows a reduction during the latter half of 1947 as compared with the first six months. As this reduction in the percentages of the older broods has been taking place since observations were resumed in August 1945, there is little doubt that it reflects the gradual elimination of the stocks allowed to accumulate during the war years.

Lemon soles taken by the "Dana" in Sundø, Lambavig and Gøtevig show the same age and growth characteristics as have already been described in dealing with earlier records from these or similar localities at Faroe.

Records by the "Dana" from Rockall Bank and Faroe Bank once again emphasize the small size and slow growth of the lemon soles in these areas.

Bennet B. Rae

Table 11.
Age Composition of Lemon Sole Catches.

Broods	Explorer June		Dana (Fjords) July		Trawlers (Jan.—June)		Trawlers (July—Dec.)	
	No.	%	No.	%	No.	%	No.	%
1946	1	0.5	—	—	—	—	—	—
1945	1	0.5	—	—	—	—	—	—
1944	2	0.9	16	14.2	2	0.2	19	1.7
1943	17	7.8	22	19.5	121	9.5	236	21.1
1942	8	3.7	6	5.3	58	4.5	82	7.3
1941	34	15.7	12	10.6	278	21.8	225	20.1
1940	11	5.1	8	7.1	64	5.0	56	5.0
1939	36	16.6	27	23.9	272	21.4	210	18.7
1938	15	6.9	4	3.5	86	6.8	58	5.2
1937	44	20.3	16	14.2	214	16.8	130	11.6
1936	21	9.7	—	—	100	7.9	63	5.6
1935	13	6.0	2	1.7	38	3.0	18	1.6
1934	9	4.1	—	—	25	2.0	19	1.7
1933	2	0.9	—	—	3	0.2	3	0.3
1932	3	1.3	—	—	4	0.3	1	0.1
1931	—	—	—	—	5	0.4	—	—
1930	—	—	—	—	1	0.1	—	—
1929	—	—	—	—	1	0.1	—	—
Total	217	100.0	113	100.0	1272	100.0	1120	100.0

Table 12. Herring Samples from Skaalefjord and Sundelaget, Faroes.

A. Length.

August—September 1946.¹⁾

Length and Sex				Length and Maturity					Length and Content of Intestinal Fat					
♀	♂	inde-term.	Total No.	I	II	III	IV	Total No.	0	1	2	3	Total No.	Av. Cont. of Fat
1	—	—	1	—	—	1	—	1	—	1	—	—	1	1.0
8	8	—	16	1	5	9	1	16	1	3	11	1	16	1.8
27	21	—	48	17	24	7	—	48	—	7	33	8	48	2.0
42	36	3	81	46	26	7	2	81	—	15	51	15	81	2.0
42	32	8	82	58	22	2	—	82	—	8	60	14	82	2.1
26	16	9	51	37	13	1	—	51	—	15	32	4	51	2.2
4	6	2	12	12	—	—	—	12	—	6	6	—	12	1.5
1	3	1	5	5	—	—	—	5	—	1	4	—	5	1.8
1	—	2	3	3	—	—	—	3	—	3	—	—	3	1.0
—	—	1	1	1	—	—	—	1	—	—	1	—	1	2.0
152	122	26	300	180	90	27	3	300	1	59	198	42	300	1.9
25.57	25.53	24.00	25.42	24.94	25.84	27.00	26.67	25.42						

28. November 1946.

Length and Sex			Length and Maturity							Length and Content of Intestinal Fat					
♀	♂	Total No.	I	II	III	IV	V	Total No.	0	1	2	3	Total No.	Av. Cont. of Fat	
—	2	2	—	—	—	2	—	2	—	2	—	—	2	1.0	
11	8	19	—	—	15	2	2	19	—	16	2	1	19	1.2	
20	29	49	—	5	32	10	2	49	—	40	8	1	49	1.2	
31	44	75	4	18	46	7	—	75	—	56	18	1	75	1.3	
27	18	45	10	15	20	—	—	45	—	31	10	4	45	1.4	
5	4	9	4	5	—	—	—	9	—	5	4	—	9	1.9	
1	—	1	—	1	—	—	—	1	—	1	—	—	1	1.0	
95	105	200	18	44	113	21	4	200	—	151	42	7	200	1.3	
26.02	26.24	26.14	25.00	25.48	26.37	26.95	27.50	26.14							

¹⁾ The samples have been secured by Mr. Árni Friðriksson for comparison with Icelandic herring; the determinations have been carried out by Mr. S. Vagnsson.

²⁾ Corrected by +0.5 cm. in all tables.

September 1946.

Length and Age.					
No. of Scales	%	III	IV	VI	inde-term.
1	0.4	—	—	1	—
16	5.7	5	11	—	—
44	16.0	33	11	—	4
74	26.7	71	3	—	7
76	27.5	71	5	—	6
46	16.6	43	3	—	5
11	3.8	10	1	—	1
5	1.8	5	—	—	—
3	1.1	3	—	—	—
1	0.4	1	—	—	—
277	100.0	242	34	1	23
	%	87.4	12.3	0.4	

28. November 1946.

Length and Age					
No. of scales	%	III	IV	V	inde-term.
2	1.0	—	2	—	—
15	7.9	8	7	—	4
27	24.6	37	9	1	2
26	73	38.2	61	12	2
25	45	23.6	39	6	—
24	8	4.2	8	—	1
23	1	0.5	1	—	—
Total No.	191	100.0	154	36	1
	%	80.6	18.9	0.5	

B. Maturity. August—September 1946.

Maturity and Content of Intestinal Fat.							Maturity and No. of Vertebrae						
Mat.	0	1	2	3	Total No.	Avg. Cont. of Fat	59	58	57	56	55	No. of Spec.	Avg. No. of Vert.
I	—	29	124	27	180	2.0	1	48	113	17	1	180	57-172
II	—	17	61	12	90	1.9	1	27	52	10	—	90	57-211
III	1	11	12	3	27	1.6	—	11	15	1	—	27	57-370
IV	—	2	1	—	3	1.3	—	1	1	1	—	3	57-000
Total	1	59	198	42	300	1.9	2	87	181	29	1	300	57-200 ¹⁾

¹⁾ The average number of vertebrae shows that the sample consists of spring spawning herring, cf. H. Wood 1935.

28. November 1946.

Maturity and Content of Intestinal Fat.						Maturity and No. of Vertebrae.							
Maturity	0	1	2	3	Total No.	Av. Cont. of Fat	59	58	57	56	55	No. of Spec.	Av. No. of Vert.
I	—	7	9	2	18	1.7	—	3	13	2	—	18	57-056
II	—	29	12	3	44	1.4	10	9	29	4	—	44	57-114
III	—	91	20	2	113	1.2	3	34	69	7	—	113	57-292
IV	—	21	—	—	21	1.0	—	4	17	—	—	21	57-190
V	—	3	1	—	4	1.2	—	—	3	1	—	4	56-750
Total	—	151	42	7	200	1.3	4	50	131	14	1	200	57-210 ¹⁾

¹⁾ Spring spawning herring.

A. Fridriksson and S. Vagnsson.

Eggs and Larvae.

Iceland

The Beginning of Spring-Spawning in Faxa Bay and Southern Coastal Waters.

Collections of fish larvae were obtained during late March and the beginning of April, 1947, in Faxa Bay and the southern coastal waters. The gear used was the Hensen net. Presumably this net collects only the earliest larval stages quantitatively. The numbers found are shown in the accompanying charts.

In the middle of March (13th—15th), fish larvae were encountered only in the southern part of Faxa Bay, hatching had begun neither in the northern part, nor in the deeper waters of the bay. All the larvae were of the Genus *Ammodytes*, presumably *A. lancea marinus* (Fig. 14).

In late March the larvae of two species, *Ammodytes* (*lancea*-group) and *Gadus virens*, were found in southern coastal waters (Fig. 15).

In the beginning of April both of these species were also found to be abundant, but at this time we also encountered the fry of other species, especially of *Mallotus villosus*. In addition we



Fig. 14.

found the beginning of hatching of *Clupea harengus*, *Gadus callarias*, *G. aeglefinus*, *G. esmarki* and *Pleuronectes cynoglossus* (Fig. 16).

Hermann Einarsson.

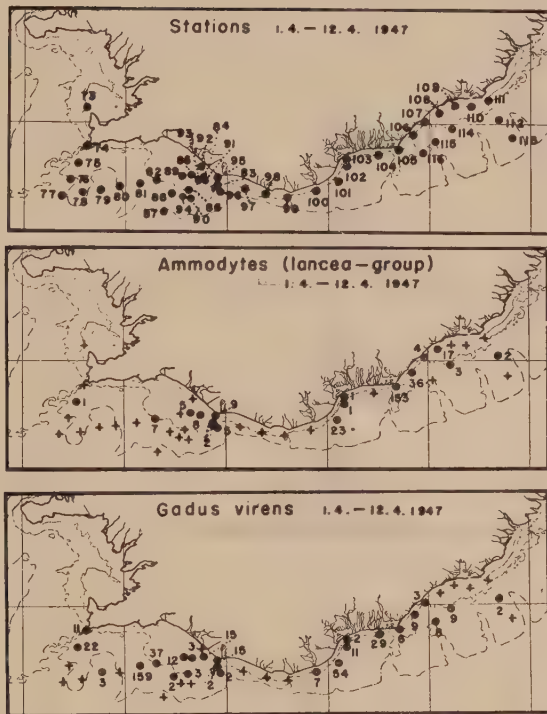
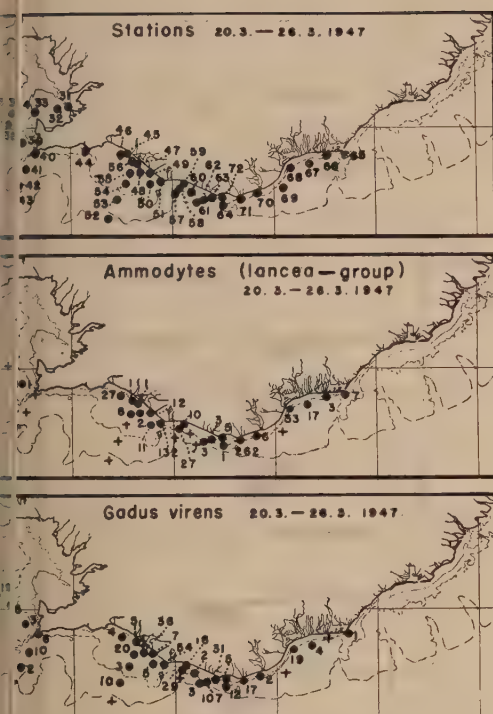


Fig. 15. Total Number per Vertical Haul (50—0 m.).

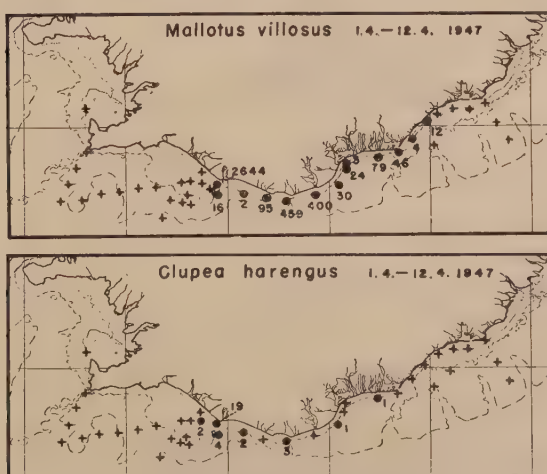


Fig. 16. See Text to Fig. 15.

Spawning off the North Coast.

The main spawning areas of the Icelandic cod are in the south and south-western coastal waters, but in recent years some spawning has also been observed off the north coast during winter and spring. In 1947 some 900 cod were examined with regard to maturity during the period of March 14th to June 19th. Of these, 25.6% were mature and had spawned that year. The following figures show percentages of spent cod during the period of observations.

March 14th	0.0%	May 18th	82.3%
April 8th	0.0%	May 30th	98.6%
April 17th	5.9%	June 19th	100.0%
April 30th	16.7%		

As indicated by the table the spawning off the north coast began in the middle of April and was completed by the middle of June. Maximum spawning intensity was observed during the first three days of May. This is about a month later than on the south coast, where 91.5% of the fish were mature and spawning that year.

Maturity.

All the material collected during 1947 has been examined with regard to sex and maturity. The material collected in 1946 has been examined with

regard to spawning zones (by Mrs. Alver, Fisheries Directorate, Bergen). The results of this examination agreed excellently with those obtained by Mr. Rollefson for the Arcto-Norwegian stock of cod. The Icelandic cod matures at the age of 4—16 years, mainly at 9 and 10 years. A difference was observed between the south and north coasts, in that the spawning takes place at

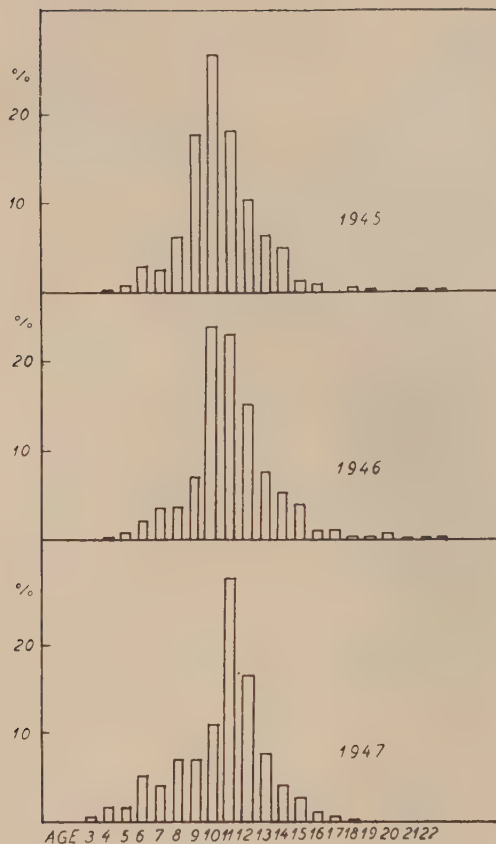


Fig. 17. Age Distribution of the Icelandic stock of cod during the winter seasons 1945—1947, from the south and south-west coast. Long-line caught fish.

an earlier age off the south coast than it does off the north coast.

Age and Length Distribution.

The otolith material from the years 1947, 1946 and 1945 has now been worked up, but only a few samples from the years 1939—44 have as yet been examined, the rest will be analysed as soon as possible.

Fig. 17 (from the spawning season at the south and south-west coast) shows that the year-classes 1935 and 1936 have been dominating the catches for the last three years. Fig. 18 shows the deviations from the average length at Keflavík (Faxe Bay) from 1931 to 1947. In the first years we can see clearly the two dominating year-classes 1922 and 1924 which were found in the catches until 1938. From 1939 to 1941 we have the two year-classes 1931 and 1932 and in 1942 we get a renewal of the stock most probably caused by the year-classes 1935 and 1936. Fig. 19 shows the deviations from the average length at 7 different stations in 1947.

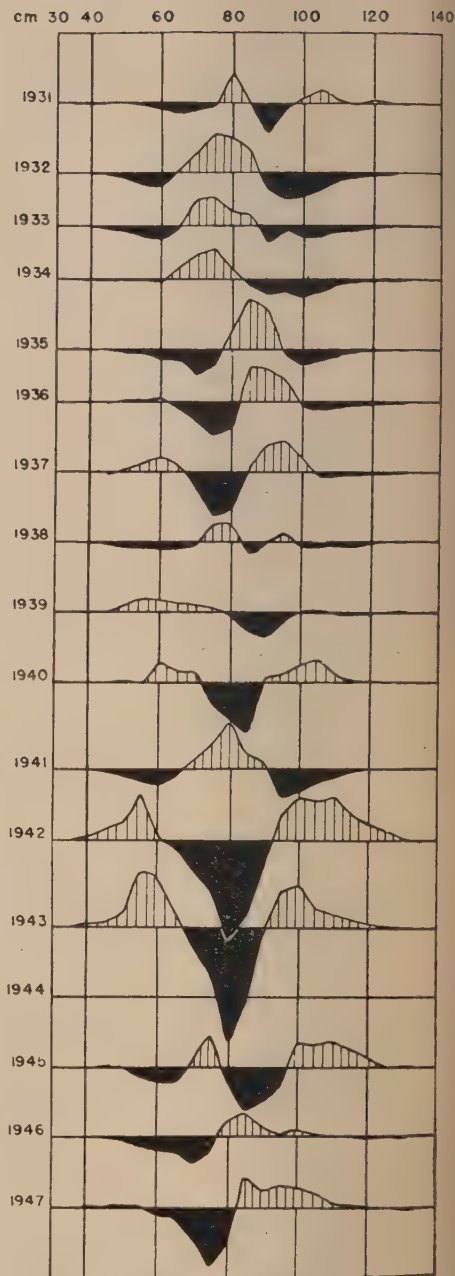


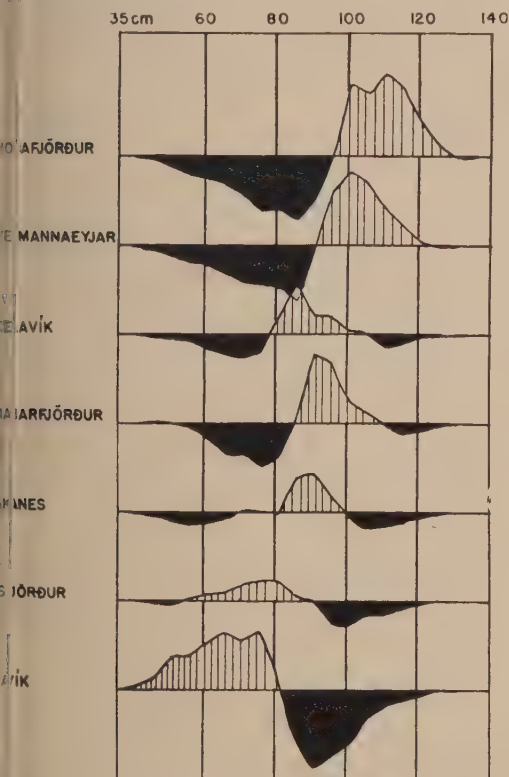
Fig. 18. Deviations from the Average Size at Keflavík (Faxe Bay) during the years 1931—1947.

The fish was, and always is, largest at Hornafjörði (south-east coast). At the Westman Islands, and the stations in Faxe Bay (Keflavík, Hafnarfjörði

(kranes) the fish is mostly of the same size, in general, smaller than at Hornafjörður. At afjörður (west coast) and especially at Dalvík (east coast) the fishery is mainly based on small

is, of course, is in full agreement with the distribution and stage of maturity of the fish at different places.

Jón Jónsson.



19. Deviations from the Average Length at different stations in 1947.

Lemon Soles.

Faxa Bay — 1946.

The first post-war collection of lemon sole catches and measurements from Faxa Bay was made by the "Dana" in September 1946. Using a 50-m. trawl, 328 lemon soles were caught in 10 hour hauls at the fixed station on the inshore grounds of the southern half of the bay and 52 were taken in the same time at the fixed station further offshore. For convenience and for comparison with earlier results these stations will hence be referred to as the territorial and extra-territorial positions respectively. Simultaneously, 128 hauls, of one hour's duration, were made with a commercial trawl, when 128 lemon soles

Table 13.

Length cm.	Territorial		Extra-terr.		Total	
	No.	%	No.	%	No.	%
<21	8	1.8	—	—	8	1.5
21—25	80	17.5	1	1.2	81	15.1
26—30	285	62.5	33	40.8	318	59.2
31—35	65	14.3	35	43.2	100	18.6
36—40	13	2.8	11	13.6	24	4.5
41 and +	5	1.1	1	1.2	6	1.1
Total	456	100.0	81	100.0	537	100.0

were caught at the territorial station and 29 at the extra-territorial station. Both these sets of figures compare favourably with the corresponding results for the years 1924—1939 and re-emphasize the heavier concentration of this species on inshore grounds.

The size frequencies, in 5-cm. groups, of the fish taken are given in Table 13.

These figures show (1) a scarcity of the smallest lemon soles, (2) a preponderance of fish of 26—30 cm., and (3) a scarcity of extra-large fish of 41 cm. and over. With regard to the first of these features, the 1946 records differ markedly from those of the period 1932—1939, but resemble those of the years 1925—1927. The percentage of fish in the 26—30 cm. group from the territorial station is higher than in any other year hitherto examined and finally the numbers of fish over 40 cm. in length are the smallest on record since investigations of the lemon soles in Faxa Bay were started in 1924.

The age analyses of the catches are given in Table 14. It shows that the large number of fish in the 26—30 cm. group were due to the good survival of the 1941 brood which supplied over 60 % of the total catch. This represents the highest percentage of a lemon sole stock by any single year-class yet experienced by the writer in any area. Table 14 also shows that the scarcity of small lemon soles in Faxa Bay in 1946 was due to the

Table 14.

Broods	Territorial		Extra-terr.		Total	
	No.	%	No.	%	No.	%
1943	19	4.2	—	—	19	3.5
1942	2	0.4	—	—	2	0.4
1941	320	70.2	16	19.8	336	62.6
1940	65	14.3	25	30.9	90	16.8
1939	20	4.4	20	24.7	40	7.4
1938	8	1.8	10	12.3	18	3.4
1937	6	1.3	—	—	6	1.1
1936	4	0.9	4	4.9	8	1.5
1935	6	1.3	2	2.5	8	1.5
1934	2	0.4	1	1.2	3	0.5
1933	1	0.2	1	1.2	2	0.4
1932	2	0.4	—	—	2	0.4
1931	1	0.2	2	2.5	3	0.5
Total	456	100.0	81	100.0	537	100.0

failure of the 1942 brood and possibly also, to some extent, of the 1943 brood. The similarity of the age composition of the younger section of the 1946 stock to the same section of the stocks during the years 1925—1927 is again remarkable. Older fish, up to 15+ years of age, on the other hand, were scarcer in 1946 than in any previous year.

The outstanding 1941 brood is also shown by Table 14 to have been densely concentrated within territorial waters, but considerably less so at extra-territorial position, where the 1940 and 1939 broods were slightly more numerous. In the case of earlier prolific broods, during the period 1924—1939, no similar local concentration was observed. It will therefore be interesting to study the subsequent distribution of the 1941 brood from future sampling.

In the absence of information regarding the amount of fishing in Faxa Bay since 1939 it is impossible to say whether or not intensity of fishing has accentuated the high numbers of the 1941 brood. It is reasonable to suppose, however, that the low percentages of the oldest fish were due to the high rate of fishing of pre-war years and that any diminution in fishing effort during the war years would tend to favour the survival of younger broods, such as that of 1941. On the other hand its distribution on inshore grounds might also support its survival.

Mean sizes in centimetres have been calculated for each age-group up to 9 years of age. These means are given in Table 15 together with the corresponding figures for the period 1925—1939.

With one exception the 1946 means are all greater than the corresponding figures for the years 1925—1939. This is to be expected since the 1946 records were collected in September, while the 1925

—1939 records were obtained in the period from 21st June to 21st August, though mainly in July. It is interesting to note, however, that the small increments, 0.3 cm. for the 5+ fish and 0.2 cm. for the 6+ fish from territorial waters, were obtained from the grounds where these year-classes were most densely concentrated. Although not itself conclusive this, nevertheless, appears to yet another indication of the depressing effect of dense populations, and the consequent keen competition for food, exert on the growth-rate of a species.

Bennet B. Rao

Herring.

The Icelandic Fishery in Faxa Bay in the Years 1946—1948.

As is well known the Icelandic herring fishery is of outstanding importance for both the herring production of Europe and the fishing industry of Iceland. This fishery, which is now nearly 70 years old, has increased very greatly since 1930, when the first Icelandic herring-meal and -oil factory was established. The season is almost entirely limited to July and August, and the fishery takes place off the north coast and the northern part of the east coast of Iceland. It is mainly based upon spring spawning herring (98.5%) with a rather low number of vertebrae ($c. 57.048 \pm 0.005$) but two other stocks are represented: a) a spring spawning herring with a high number of vertebrae (57.509 ± 0.092) making up about 0.3% in a normal year, and summer spawners amounting to about 1.2% of the total stock by number.

These two last-named stocks, which are certainly of Icelandic origin, are the main components of the herring catches off the south and south-west coasts of Iceland, where drift-net fishing has been carried on during the summer for nearly 50 years. Here the summer-spawning stock has been the most predominant one, contributing 75%—85% of the total catch in these waters.

During the last four years a very important development has taken place. The two southern stocks have increased immensely, and have given rise to a completely new herring fishing season in Faxa Bay from October to February (March).

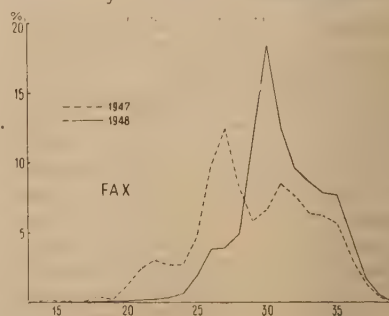


Fig. 20.
Size Distribution
(in cm.) of
Herring caught
in Faxa Bay, Octo-
ber 1947 (1947) and
February 1948
(1948).

Table 15.

September 1946 21 June—21 August 1925—1939

	Territorial			
	No.	Mean	No.	Mean
3+	19	20.3	241	19.5
4+	2	25.5	289	23.7
5+	320	27.5	306	27.2
6+	65	29.4	343	29.2
7+	20	30.6	176	31.2
8+	8	34.4	147	33.1
9+	6	35.5	56	34.5
	Extra-territorial			
	No.	Mean	No.	Mean
3+	—	—	75	19.7
4+	—	—	175	24.5
5+	16	29.0	237	27.9
6+	25	30.6	162	30.0
7+	20	32.2	28	31.8
8+	10	34.2	39	33.6
9+	—	—	10	34.8

now had two such seasons, in 1946—1947 and 1947—1948. The principal gear used has been purse-seine and the total catch has been about 3000 hl. in the first and about 1,800,000 hl. in the second season. I will now give a survey of the herring stock upon which this new fishery is based.

Age and Size. In Table 16 a survey is given of the age composition and the size distribution of the herring caught in February 1947. The size ranges from 14 cm. to 38 cm. and the average length was found to be 29.05 cm. The graph, Fig. 20, illustrating the size distribution, shows fairly clear peaks at 15, 22, 27 and 31 cm. correspond-

ing to Feb. 1948. The average length is considerably higher than in the previous year; it has increased from 29.05 to 31.76, or by nearly 3 cm. The length ranges from 18 cm.—39 cm., the 14 cm.—17 cm. size groups not being represented. As regards the age composition it is evident that we have to deal with the same year-classes as in 1946—1947, but a new I-group is missing. The 1944 group is dominating, representing more than a third of the catches (37.6 %). The increased size of the fish in this season is due to a year's growth rather than an inflow of older fish into the stock.

Turning now to the curves in Fig. 20 we will see that their shape is very similar, and that the 1948 (1947—1948) curve is pushed to the right owing to a year's growth. This is further shown in Fig. 21 where the age composition through both seasons is illustrated, also in comparison with the north coast herring. It is clear that the herring stock in Faxe Bay is quite different from the north coast stock as regards age (and also size). The north coast stock is much older and quite different year-classes are dominant.

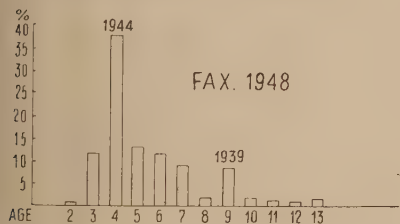
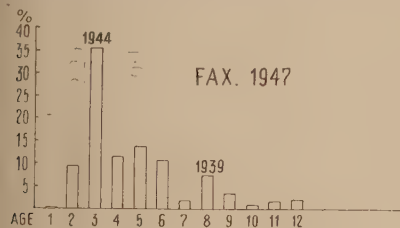


Fig. 21. Age Composition of the Faxe Bay Herring in 1947, (1946—1947) and 1948 (1947—1948) and of the North Coast Herring in the summer of 1947.

to 1, 2, 3 and 5-year-old herring. As shown in Table 16, we find herring from 1 to 18 years of age in this material. The bulk of the stock (6 %) is 2—8 years old, only 0.1 % being younger and 8.3 % older. The dominating year-classes is the 3-year-old herring, representing the bulk from 1944, but in addition, 2, 4, 5 and 6-year-old fish are quite numerous and the 8-year-olds can be traced as relatively important. The average lengths of the age-groups, as well as their growth, can be seen in Table 16.

Table 17 comprises material (4,207 fish) collected throughout the whole season from Nov. 1947

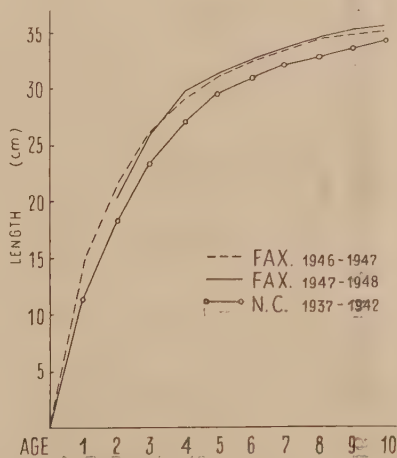


Fig. 22. Growth Rate of Faxe Bay and North Coast Herring.

2. Growth. The difference between the herring from Faxe Bay and from the north is also reflected in the growth rate, as is shown in Fig. 22. On the whole the growth rate for the Faxe Bay herring of 1946—1947 and 1947—1948 is nearly identical, whereas that of the north coast herring is considerably slower. This difference is so pronounced that a 3-year-old herring from Faxe Bay has reached nearly the same size as a 4-year-old herring from the north and, when 4 years old, the Faxe Bay herring is actually larger than the 5-year-old north coast herring and it mainly seems to reach maturity at that age (4 years).

Table 16. Age and Size Distribution February 1947.

Cm.	1	2	3	4	5	6	7	8	9	Age 10	11	12	13	14	15	16	17	18	No.	%
38	—	—	—	—	—	—	—	—	—	3	—	—	2	1	—	1	—	—	7	0.4
37	—	—	—	—	—	—	—	—	3	4	8	8	3	—	1	—	—	—	23	1.3
36	—	—	—	—	—	—	—	11	8	4	12	13	3	—	—	—	—	—	52	3.2
35	—	—	—	—	—	2	5	47	22	4	6	6	1	—	—	—	—	—	93	5.7
34	—	—	—	—	—	18	11	47	17	3	2	2	1	—	—	—	—	—	101	6.2
33	—	—	—	1	7	67	18	7	1	3	1	—	—	—	—	—	—	—	105	6.4
32	—	—	—	2	62	60	3	—	—	—	—	—	—	—	—	—	—	—	127	7.7
31	—	—	—	11	109	20	—	—	—	—	—	—	—	—	—	—	—	—	140	8.5
30	—	—	1	61	42	5	—	—	—	—	—	—	—	—	—	—	—	—	109	6.6
29	—	—	10	71	13	1	—	—	—	—	—	—	—	—	—	—	—	—	95	5.8
28	—	—	101	37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	138	8.4
27	—	—	181	23	—	27	—	—	—	—	—	—	—	—	—	—	—	—	204	12.4
26	—	—	158	3	—	26	—	—	—	—	—	—	—	—	—	—	—	—	161	9.8
25	—	—	76	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	77	4.7
24	—	5	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	45	2.7
23	—	28	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	45	2.7
22	—	46	3	—	—	22	—	—	—	—	—	—	—	—	—	—	—	—	49	3.0
21	—	39	1	—	—	21	1	—	—	—	—	—	—	—	—	—	—	—	40	2.4
20	—	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17	1.2
19	—	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	0.2
18	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	0.4
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.1
15	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.1
14	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.1
Total Number	2	146	589	210	233	173	37	112	51	17	28	29	10	1	2	1	—	1	1642	100.0
%	0.1	8.9	36.0	12.8	14.2	10.6	2.3	6.8	3.1	1.0	1.7	1.8	0.6	+	0.1	+	—	+	100.0	
Av. Length	14.50	21.47	26.32	28.98	31.03	32.43	33.49	34.55	34.90	35.06	35.89	35.93	36.40	38.00	36.50	38.00	—	37.00	29.05	

Table 17. Age and Size Distribution Nov. 1947—Feb. 1948.

cm.	2	3	4	5	6	7	8	9	10	Age 11	12	13	14	15	16	17	No.	%
39	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	0.0
38	—	—	—	—	—	—	1	—	1	1	4	7	—	3	1	1	19	0.5
37	—	—	—	—	—	—	—	13	9	15	11	24	2	5	—	1	80	1.9
36	—	—	—	—	—	3	6	75	38	23	21	32	1	—	—	1	200	4.7
35	—	—	—	—	3	54	42	177	29	9	9	7	—	—	—	—	330	7.7
34	—	—	1	1	64	157	27	78	4	4	—	—	—	—	—	—	336	7.9
33	—	—	1	34	187	130	7	4	—	—	—	—	—	—	—	—	363	8.6
32	—	—	28	161	190	23	2	1	—	—	—	—	—	—	—	—	405	9.6
31	—	—	246	222	48	4	—	—	—	—	—	—	—	—	—	—	520	12.5
30	—	2	658	105	5	—	—	—	—	—	—	—	—	—	—	—	770	18.4
29	—	12	482	18	—	—	—	—	—	—	—	—	—	—	—	—	512	12.2
28	—	72	133	—	—	—	—	—	—	—	—	—	—	—	—	—	205	4.9
27	—	139	26	—	—	—	—	—	—	—	—	—	—	—	—	—	165	3.9
26	—	155	4	—	—	—	—	—	—	—	—	—	—	—	—	—	159	3.8
25	—	77	1	—	—	—	—	—	—	—	—	—	—	—	—	—	78	1.9
24	—	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	26	0.6
23	—	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	0.3
22	1	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	0.2
21	5	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	0.2
20	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	0.1
19	4	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	0.1
18	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	0.1
Total Number	15	506	1580	541	497	371	85	348	81	52	45	71	3	8	1	3	4207	100.0
%	0.4	12.0	37.6	12.9	11.8	8.8	2.0	8.3	1.9	1.2	1.1	1.7	0.1	0.2	0.0	0.1	100.0	
Av. Length	20.25	26.20	29.66	31.17	32.54	33.65	34.55	35.03	35.68	36.00	36.22	36.48	36.67	37.37	38.00	37.00	31.76	

3. Maturity. The material has been analysed according to stages of maturity in relation to age. The result is shown in Fig. 23. While the one-year-old fish originate from February 1947 all the other groups come from the season 1947—1948. As could be expected, the I-group is entirely at stage I, whereas the two-year-olds have partly advanced to stage II. A very small fraction of the three-year-olds is approaching maturity (stage V), the rest remaining mostly at stages II and III. When the age of 4 years has been reached, two remarkable alterations have taken place. There are now no more fish at stage I and very few at stage II, and, at this time of year (Nov.—Feb.), there is a distinct grouping at two stages, III and V. This grouping is also found among the older fish, as may be seen in the figure. There is no doubt that the herring at stage III are summer spawners and the ones at stage V are spring spawners. This fact is also

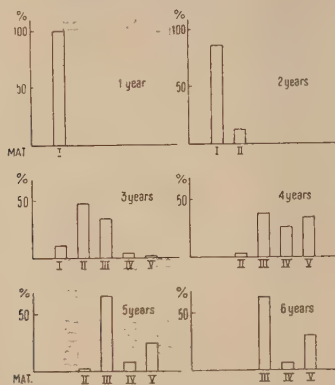


Fig. 23. Stages of Maturity (Mat.) in Relation to Age, Faxa Bay 1947 to 1948.

supported by the number of vertebrae (see la). The herring at stage IV, might be a mixture of spring and summer spawners, but according to the high number of vertebrae they must almost all be spring spawning herring.

If we consider the percentage of herring at different maturity stages throughout the season, we come to the following result (1947—1948):

	Nov.-15th Jan.	16th-31st Jan.	1st-15th Feb.	16th Feb.
Stage I—II	9.9	5.3	4.4	3.0
Stage III	43.3	40.1	55.2	84.0
Stage IV	14.9	14.1	9.4	8.0
Stage V	31.9	40.5	31.0	4.0
Total	100.0	100.0	100.0	100.0

It is worth noting that the spring spawners appear towards the end of the season; they move into warmer waters in order to spawn. Exactly the same thing happened in spring 1947, when stage V herring constituted 31.2% during the period February 11th—20th and only 1% during the period February 21st—28th.

4. Number of Vertebrae. In Table 18 a summary is given of the total number of vertebrae in the Faxa Bay and north coast herring, the great bulk of which were at stage III during the summer (spring spawners). If we consider the average number of vertebrae, it is evident that we have to deal with three groups of herring: The north coast herring with well over 57 vertebrae and a tendency to increased numbers in recent years, the south coast spring spawning herring (Faxa Bay, stages IV and V) with relatively high vertebral counts and finally the summer spawners (Faxa Bay, stage III) with relatively low number of vertebrae. A glance at Table 19 will give a fairly good idea of the heterogeneity of the material dealt with in T

Table 18.
Total Number of Vertebrae in Faxa Bay Herring of different Maturity Stages and of North Coast Herring.

V _s	Faxa Bay 1946—1948						N. Coast (Total)		
	I	II	III	IV	V	Total	1946	1947	1937-42
60	—	—	—	—	—	—	1	—	4
59	5	1	12	8	19	45	32	22	113
58	50	112	468	210	424	1264	877	624	3432
57	156	269	1909	395	902	3631	2586	1758	11427
56	29	84	546	51	131	841	558	367	2603
55	11	1	18	2	3	25	26	12	71
54	—	—	5	2	3	10	4	2	20
53	—	—	2	—	—	2	—	1	3
N	241	467	2960	668	1482	5818	4084	2786	17673
%	4.1	8.0	50.8	11.4	25.7	100.0			
M	57.120	57.060	56.962	57.247	57.213	57.073	57.079	57.095	57.048
±m	0.041	0.030	0.012	0.025	0.017	0.009	0.010	0.012	0.005

Disregarding groups I and II which represent mixture of summer spawners and local spring spawners, we come to the following conclusions:— Group III, the summer spawners, is totally different from all other herring, especially from the spring spawners, which are distinguished by having the highest number of vertebrae. Group IV is significantly different from both north coast herring and the summer spawners, very similar to the herring at stage V. It must therefore, as already pointed out, be regarded as spring spawning herring. Group V has already been compared with III and IV, but it is evident that it is quite different from the large stock of north coast herring, especially in a normal year. It is particularly interesting to note, that groups IV and V are more similar to the north coast stock as it was in 1946, even more so as it was in 1947, than in a normal year (1937—1942). This seems to mean, that the north coast stock has been mixed with relatively small quantities of local spring spawners in the last, abnormal seasons.

Fishing Localities etc. In the two seasons with here, the fishing has, without exception, taken place in the fjords, close to the coast. In 1946—1947 the best grounds were situated in Kollafjörður and just outside the harbour at Reykjavík (Fig. 24), but in 1947—1948 the catches were almost exclusively taken within a rather limited area in the Hvalfjörður. This fjord is rather shallow near the mouth, about 40 m., but considerably deeper (80 m.) inside. Consequently the water masses are more or less stagnant here during winter, with surface temperature down to 1°C. or less in January and still lower temperatures in deeper waters, while, at the same time, the Atlantic water at the mouth of Faxa Bay is at 5°C. or more. In our opinion, there is no doubt that the great accumulation of herring in this fjord last winter is easily explained physically. The herring masses

have been transported into the fjord passively by the currents and have then been stationary there for some time. This opinion is supported by several facts, the first of which is the morphological feature of the fjord. There was practically no herring food in the fjord, a fact which excludes the possibility of a feeding migration. A spawning migration is quite unacceptable, as less than half the stock would spawn next spring, the temperatures were far too low for spawning, and the herring left the fjord for spawning at the end of February, when full maturity was reached.



Fig. 24. Chart of the SE. part of Faxa Bay showing Kollafjörður and Hvalfjörður.

Table 19.

Standard Deviations of the Differences

Table 18) calculated by $\frac{M_1 - M_2}{\sqrt{m_1^2 + m_2^2}} \cdot 2$.
is regarded as a significant Difference if
the Deviation is > 3 .

	1937-42	1946	1947	V	IV	III	II
I	1.8	1.0	0.6	2.1	2.6	3.7	1.2
I	0.4	0.6	1.1	4.6	4.8	3.1	
I	6.6	7.3	7.8	11.9	9.8		
V	7.7	6.0	5.2	1.1			
V	9.2	7.1	5.6				
7	2.4	2.9					
6	1.5						

6. Conclusions. The recent herring fishing in Faxa Bay is based upon two stocks of herring which are of Icelandic origin, the summer spawning herring and a spring spawning herring with a high number of vertebrae. They are both morphologically different from the large spring spawning herring stock upon which the summer fishing off the north coast is based. The two stocks have expanded tremendously during the last ten years, especially in 1944, when there was a very strong brood in both stocks. The summer spawning herring must be supposed to be more or less stationary off the south and south-west coasts during summer, when spawning takes place. The spring spawning stock, on the other hand, will be carried to the north with the Gulf Stream after having finished spawning in the spring. In summer it will be mixed with the

north coast herring, the result of which will be a tendency to an increase in the number of vertebrae. The great accumulation of herring in the Faxa Bay fjords is very probably due to hydrographical causes.

Arni Fridriksson.

Norwegian Herring Investigations.

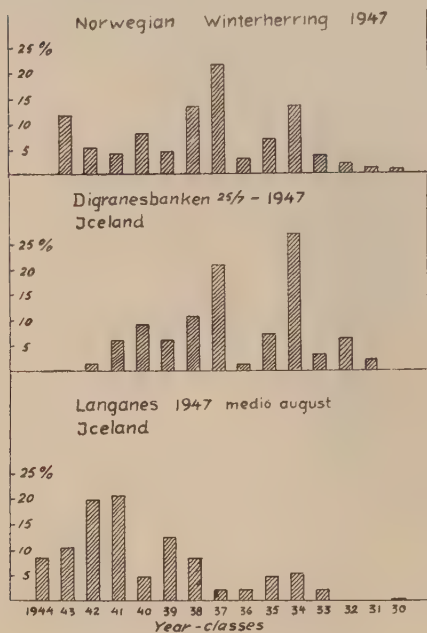


Fig. 25.

During the cruise of a patrol vessel in Icelandic waters, two samples of herring were collected, one from Digraanes Bank and one from Langanes. The sample from Langanes seems to belong to what Arni Fridriksson terms the "B-type". The age distribution of the sample from Digraanes Bank shows a remarkable similarity to that of the Norwegian winter herring. Mr. Thorolf Rasmussen has read the scales and determined the growth increments. The northern type of the 1937 year-class of the Norwegian winter herring shows a remarkably small growth increment in its 4th year. This year-class is thus, in a way, marked by nature. We find the same small increment in the 4th year of the 1937 year-class from Digraanes Bank. These two facts support the theory of Arni Fridriksson that the Norwegian winter herring and the "A-type" of the Icelandic herring belong to the same tribe. The age distribution, and the growth rates in the different years for the 1937 year-class, are shown in the accompanying graphs (Figs. 25 and 26). The graphs and tables will be treated in a special paper by Thorolf Rasmussen.

Finn Devold.

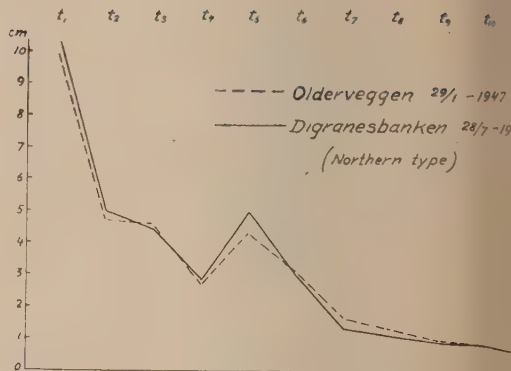


Fig. 26. The growth rate of the 1937 year-class, Olderveggen Norway and Digraanesbank Iceland.

The Location of the Herring Fishery off North and East Iceland during the Summer of 1947.

An attempt was made during the summer herring season of 1947 to distribute index cards among the Icelandic fishermen in order to get information on the localities where catches were made with the purse seine.

On one side of these index cards there was printed form to be filled in by the fishermen stating:—

1. The duration of the fishing tour.
2. Date of day of fishing.
3. Catch per day.
4. Locality of catch.
5. Number of shots.
6. Remarks on temperature, Calanus and other observations.

On the other side of the index card was printed a chart of the fishing grounds where the locality of the catches were to be marked by an asterisk.

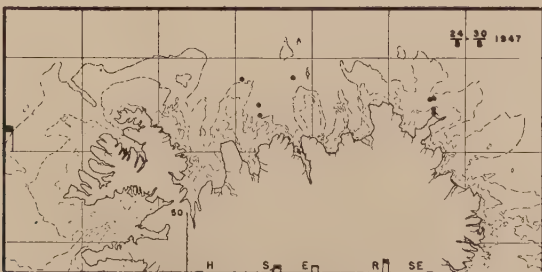
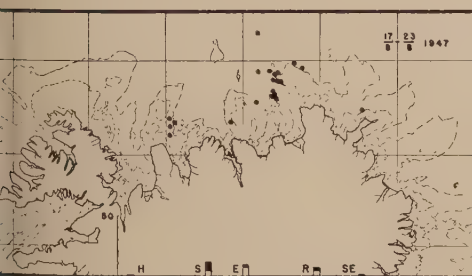
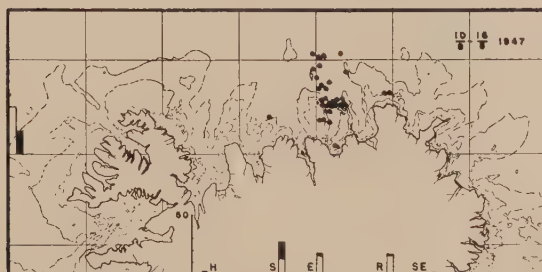
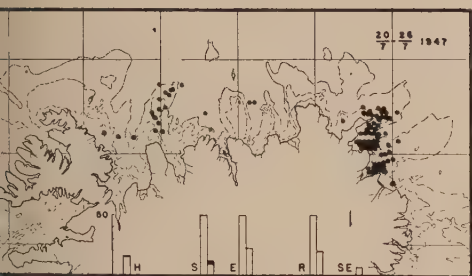
These index cards were filled in by the captains of vessels landing their catch in Siglufjörður.

We consider this attempt successful, and intend to distribute similar catch record forms to the whole fleet next season.

On the basis of the index cards collected during the summer of 1947, we have drawn the accompanying charts of the distribution of the herring fishery during the summer of 1947.

Each dot represents the record of one index card. The records are arranged according to the week in which the catch was made.

The histograms below show the quantity of herring received in various areas of the north and east coasts.



in 1,000 hl. (see scale to the left). We distinguish between the following areas: H. — Húnaflói, S. — Siglufjörður, E. — Eyafjörður, R. — Reykjavík and SE. — Seydisfjörður.

Below, to the left, the total quantity received

at all ports during the week is shown on the same scale. White columns show the quantity received by the herring-oil factories. Black columns show the quantity received by the salteries.

Hermann Einarsson.

Plateau Continental Atlantique.

INTRODUCTION.

NT apporté leur contribution à la rédaction de ce rapport sur les observations faites pendant l'année 1947 dans le secteur du Continental Atlantique:

Mr. A. E. J. Went, Eire,
Mr. F. S. Russell, Angleterre et
les Collaborateurs de l'Office Scientifique et
Technique des Pêches Maritimes:
MM. Forest, J. Furnestin,
R. Letaconnoux et E. P. Priol
(France).

Ces contributions isolées ne permettent pas de tirer de conclusions d'ensemble sur l'activité, encore réduite, dans le secteur du Plateau Continental Atlantique.

Jean Le Gall.

LES CONDITIONS DE MILIEU.

Phosphates.

Routine phosphate determinations at International Station E1 were resumed on November 6th 1946. More extensive investigations were made in January 1947, the westernmost station being at 49°50'N., 7°58'W. Iron determinations were made (Cooper, Journ. Mar. Biolog. Assoc., 1948, 27, 270—313) and revealed a distribution very different from that for phosphate. Much of the iron was distributed as particles including, probably, particles of ferric phosphate amounting on an average to about 0.06 mg.—mol/m³. As a result, the original phosphate data now need to be recalculated to allow for the presence of this ferric phosphate. Much of the Western English Channel at the time of the winter maximum in January 1947 was filled with water containing about 0.5 mg.-atom phosphate P/m³, similar to that which has occupied the Channel at midwinter for many years. There were, however, areas of high phosphate (>0.60 mg.-atom/m³) and a homogeneous lenticular-shaped patch extending north from the Brittany Coast containing only 0.4 mg.-atom/m³ P or less and possessing relatively high temperature and salinity.

Near Plymouth there has been no evidence of any change from the conditions present in 1933—38.

Marine Biological Association, Plymouth.

Plancton et Jeunes Poissons

Observations on the abundance of young fish and plankton in Plymouth off-shore waters have been continued throughout 1947. Standard 1/4 oblique hauls with the 2-metre stramin ring are taken near the Eddystone light-house.

In 1947, the total of all species of young fish was the lowest recorded since the observations began. All summer spawners were very scarce; spring spawners were present in only slightly greater numbers, occurring mainly in two small peaks, the second halves of February and May. *Chirolophis galerita* contributed only slightly to the February peak, and the May peak was largely due to *G. merlangus* and *Callionymus* spp. The 1947 total (1403) of all species of young fish for the whole year was only 16% greater than the 1946 total (1203) for the seven-month period from January to December.

Indicator species showed no change from the conditions prevailing in 1946. *Sagitta* was although never numerous and almost completely absent during May—July, predominated over other species. *Muggiaea atlantica* was present in considerable though not exceptional numbers from January to March and from August to December; it was entirely absent during April to July. *M. kochi* was not occur.

Marine Biological Association, Plymouth.

LES POISSONS.

Morue.

La Population de Morue de l'Entrée de la Manche.

Les chalutiers rochelais rapportent, surtout en été, des fonds de pêche de l'entrée de la Manche (Jones Bk.), de petites quantités de morues représentant au total 1% des apports de 1947 à La Rochelle.

Les observations effectuées montrent que cette population ne se compose que de jeunes morues de 40 à 90 cm. La grande majorité se groupe autour de 50 cm, ce qui correspond à des individus ayant

deux anneaux d'hiver (78%). Les autres groupes ne sont que faiblement représentés: 16% pour le groupe III et 3% pour le groupe IV.

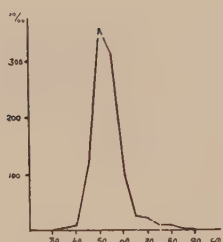
En Juillet, la taille moyenne de chacun des trois groupes est respectivement de 52, 69 et 80 cm.

Le nombre moyen des rayons de la série dorsale est de 18.90 ± 0.283 .

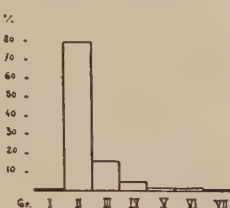
Ces caractères permettent de considérer que les jeunes morues représentent une partie distincte de la population, dont les adultes se réunissent en Mars en provenance d'Irlande pour frayer.

Taille des divers Groupes.

I	II	III	IV	V	VI	VII
—	1	—	—	—	—	—
1	3	—	—	—	—	—
—	19	—	—	—	—	—
—	42	1	—	—	—	—
—	33	—	—	—	—	—
—	19	3	—	—	—	—
—	3	3	—	—	—	—
—	—	8	—	—	—	—
—	—	7	2	—	—	—
—	—	2	2	—	—	—
—	—	—	—	—	—	—
—	—	—	1	2	1	—
—	—	—	—	—	—	—
—	—	—	—	—	1	1
1	120	24	5	2	2	1
0.5	78	16	3	1	1	0.5
38	52	69	80	89	96	101



Courbe de population.



Représentation des diverses classes.

Fig. 1.

Nombre de rayons à la D2	16	17	18	19	20	21	22
Nombre d'individus	3	12	59	69	45	11	2

R. Letaconnoux.

lu.

Composition du Stock de Merlu en 1947.

Merlu. Le stock de merlus a constitué 38 0/0 de la pêche de 1947 à la Rochelle. Les mensurations effectuées en Février—Mars à la Petite Sole montrent qu'entre 60 et 80 cm., ce stock était bien représenté; mais que la classe autour de 50 cm. était peu importante. Or, cette classe était également faiblement représentée dans le stock de merluchons et se composait d'individus ayant moins de 5 ans au début de l'année. Il est donc possible d'affirmer qu'en 1947 le stock de merlus et de merluchons était bien fourni à l'exception d'une classe déficitaire, celle des individus ayant cinq ans au début de l'année.

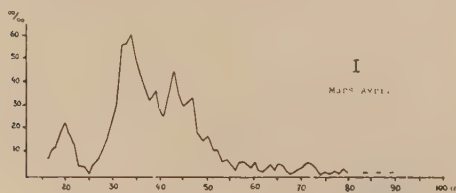


Fig. 2. Fréquence des tailles en Mars—Avril.

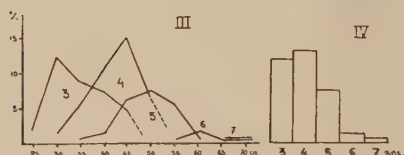
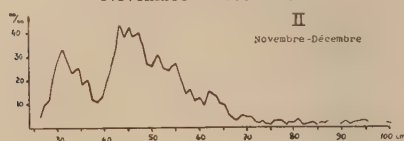
Mensurations.

Date: 1947	Mars-Avril	Mars-Avril	Nov.-Déc.
Origine	Petite Sole	Banc Cockburn	Jones-Bk.
cm.	Nombre d'individus pour mille.		
15	0	19.3	0
20	0	85.8	0
25	0.7	21.4	14.5
30	1.4	138.4	130.9
35	11.8	244.4	101.9
40	43.6	154.3	101.9
45	56.8	172.5	205
50	66.1	71.7	145.8
55	83.2	26.4	114.9
60	144.7	20.2	66.7
65	167.1	17.3	47.6
70	162.7	11.2	22.6
75	99.9	7	10.6
80	46.3	4.1	11.7
85	40.2	4	7
90	33	1	7.8
95	27.7	1	6.9
100	7.9	2	2.4
105	3.8	0	4
110	0	0	0
115	3.1	0	0
	1000	1000	1000

Merluchon. Durant la plus grande partie de 1947, un important stock de merluchons se trouvait sur les fonds de l'Entrée de la Manche (Cockburn, Melville, Jones Bk.). Celui-ci a fourni 13 % de la pêche totale des chalutiers hauturiers et 25 % des apports de Merlu à La Rochelle.



I et II. Fréquence des tailles en Mars—Avril et Novembre—Décembre.



III. Composition du stock en fin d'année selon l'âge des individus.

IV. Pourcentage de chaque classe.

Fig. 3.

Hareng.

Sizes and Age Groups of Irish Herring Samples 1947.

Locality	Date	Length in cm. expressed as Percentage of Sample									
		22	23	24	25	26	27	28	29	30	31
Arklow	12/6/47	—	3.4	18.6	27.8	39.5	6.9	3.4	—	—	—
Baltimore	25/9/47	—	—	1.3	0	13.1	35.5	26.3	17.1	3.9	2.6
Carlingford	2/10/47	0.4	7.1	40.8	36.4	13.4	1.7	—	—	—	—
Age-Groups as Percentage of Sample											
		2	3	4	5	6	7	8			
Arklow	12/6/47	23.6	47.3	19.7	9.2	—	—	—			
Baltimore	25/9/47	21.8	14.0	23.4	12.5	23.4	3.1	1.5			
Carlingford	2/10/47	72.5	25.4	1.0	1.0	—	—	—			

E. D. Toner.

Pilchard and Herring. During the winter of 1947—48, Cornish motor-drifters, working from Plymouth, made exceptionally good catches of pilchards.

Au début de l'année (Mars—Avril) nous avons trois classes bien indiquées autour de 20, 30 et 45 cm. En fin d'année nous les retrouvons autour de 30, 45 et 55 cm. Une quatrième classe, bien moins importante, autour de 50 cm., montre également une croissance de 10 cm. en septembre se retrouvant en Décembre aux environs de 60 cm.

L'examen des otolithes, effectué en Décembre sur 249 individus, a montré que ce stock se composait de merluchons ayant de deux à six ans d'hiver, c'est-à-dire de trois à sept ans. Les individus de trois et quatre ans étaient particulièrement nombreux (35 et 39 %) et constituaient avec ceux de cinq ans (22 %) la presque totalité du stock. La classe de six ans n'était que d'une importance très réduite (3 %).

cm.	Gr. II	III	IV	V	V
25	1.6	—	—	—	—
30	12.4	1.6	—	—	—
35	8.8	5.3	0.4	—	—
40	7.2	10.5	1.6	—	—
45	4.8	15.3	6	—	—
50	—	6.8	7.2	—	—
55	—	—	5.3	0.4	—
60	—	—	1.6	1.6	—
65	—	—	—	0.4	0.4
70	—	—	—	0.4	0.4
t. 0/0.	35	39	22	3	—

R. Letaconnou.

Some herring were taken on occasions, but never in bulk. It is clear therefore, that there was no large scale arrival of spawning shoals of herring.

Marine Biological Association, Plymouth.

ne (*Clupea pilchardus*).

ensurations de sardines faites pendant la sai-
pêche de la sardine sur la côte Sud de Bre-
(Juillet—Octobre 1946).

bservations montrent:
présence d'une seule classe dans les concen-

servateur: E. P. Priol.

Sardines capturées au filet dérivant

Taille en cm.	Concarneau	
	5-11 Juillet 1946	22 Octobre 1946
	0/0	0/0
10	—	2
11	—	26
12	—	55
13	0.3	14
14	29.6	2
15	40.6	1
16	24.2	—
17	5.2	—
18	0.2	—
N	1,137	1,000
Mode	15	12
Moyenne	15.06	11.91
	(+0.50)	(+0.50)

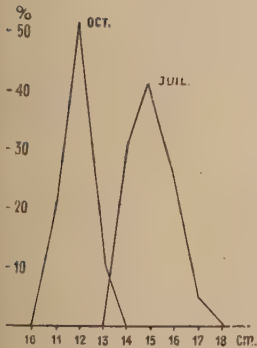
trations sur les pêcheries de la côte sud de Bretagne
en Juillet (Concarneau) et en Septembre (Baie
d'Audierne).

L'apparition d'une deuxième classe plus jeune
en Octobre sur la côte sud de Bretagne (Concar-
neau) et en Baie d'Audierne où elle se trouve avec
la classe plus âgée, déjà présente dans cette région
en Septembre.

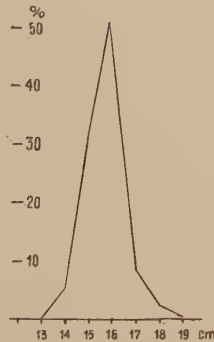
J. Le Gall.

Sardines capturées à la senne tournante.

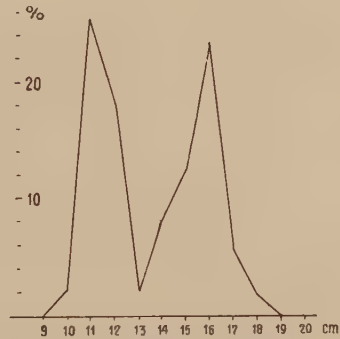
Taille en cm.	Baie Audierne	
	27/8-10/9	14-24 Octobre
	0/0	0/0
10	—	2.3
11	—	26.1
12	—	18.7
13	0.1	2.0
14	5.0	8.0
15	33.1	12.0
16	51.0	23.0
17	8.2	5.7
18	2.2	2.0
19	0.4	0.2
N	764	1,640
Mode	16	11
Moyenne	15.757	16
	(+0.50)	



Filets dérivants.
Juillet et Octobre.



Senne tournante Audierne.
Août.



Senne tournante Audierne.
Octobre.

Fig. 4.

maquereau (*Scomber scombrus* Linné).

A. Concentrations de ponte.

(Voir le tableau de la page suivante.)

ous ces poissons étant au stade VI, on se
ve donc en présence de concentrations de ponte.
proportion de mâles et de femelles dans chaque
est sensiblement égale.

es résultats confirment:

— que la pêche du maquereau débute au sud
d'Irlande dès le début de Mars et qu'elle se
suit de plus en plus près du littoral à mesure
la saison avance;

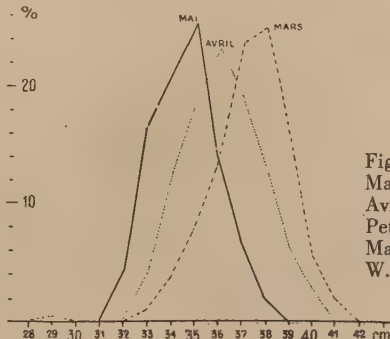


Fig. 5.
Mars. Sud Irlande.
Avril. Cockburn.
Petite Sole.
Mai. 20 milles
W. Penmarch.

A. Concentrations de ponte.

Observateurs: MM. Letaconnoux — Forest — Priol

Origine	cm.	N.	27	28	29	30	31	32	33	34	35	36	37	38	39
1—2/3/46															
50°20'N.															
9°20'W. Gr.		563	—	0.2	0.5	0.2	—	0.2	1.2	3.9	8.0	13.3	24.0	24.8	15.8
7/4/46															
48°30'N.															
9°W. Gr.		—	—	—	—	0.2	0.2	0.2	4.3	12.6	18.4	23.1	18.8	12.8	6.2
18/5/46															
30 milles															
Ouest Penmarch		—	—	—	—	—	1.7	4.6	16.3	28.0	25.1	14.1	6.6	2.1	1.5

— que les individus se rassemblant sur les frayères de l'espèce sont d'autant plus jeune la ponte est plus tardive et que les frayères se rapprochent de la zone côtière (voir courbe distribution en Mars—Avril—Mai).

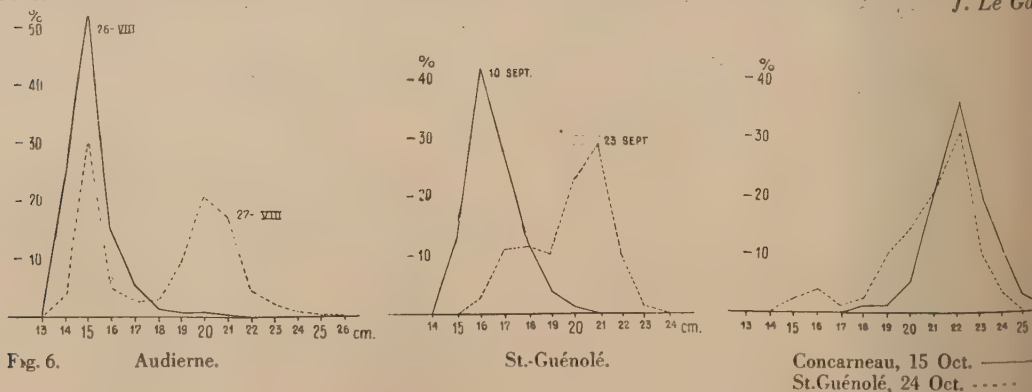
B. Rassemblements d'immatures.

Observateur: M. E. P. Priol

Origine	N	13	14	15	16	17	18	19	20	21	22	23	24	25
26/8/46														
Senne														
Baie Audierne	442	0.2	23.8	52.6	15.4	5.2	1.1	0.9	0.7	0.2	—	—	—	—
27/8/46														
Senne														
Baie Audierne	579	—	3.6	30.6	5.0	2.4	3.1	9.1	20.5	17.4	4.7	2.1	0.9	0.4
9—10/9/46														
Senne														
St.-Guénolé	784	—	0.1	12.1	42.5	28.0	12.1	3.9	1.3	—	—	—	—	—
23/9/46														
Senne														
St.-Guénolé	562	—	—	—	2.7	11.3	11.9	10.1	23.3	29.0	10.0	1.7	—	—
5/10/46														
Haveneau														
Concarneau	414	—	—	—	—	—	0.9	0.7	5.3	21.0	36.2	19.1	11.6	3.4
15—24/10/46														
Senne														
St.-Guénolé	269	0.3	0.4	2.1	3.9	1.0	2.1	10.9	13.3	21.1	31.2	10.1	3.5	—

Ces mensurations montrent la présence simultanée de deux classes distinctes de *Scomber* brus immatures sur la côte sud de Bretagne. Mode 15 et mode 20 en Août retrouvés dans les m

J. Le G



C. Méditerranée.

Scomber scombrus et *Scomber colias*
 — Travers du Cap Méjean et
 Séquent du Planier (Marseille)
 — Lamparo (de nuit) Date — Juin—Juillet

Longueur totale (en cm.)	Nombre d'individus mesurés	Représentation ‰
15	65	2.1
16	587	18.9
17	509	16.4
18	242	7.8
19	79	2.5
20	65	2.1
21	28	0.9
22	1	0.0
23	—	—
24	—	—
25	2	0.1
26	8	0.3
27	36	1.1
28	144	4.6
29	238	7.6
30	304	9.8
31	292	9.4
32	236	7.6
33	102	3.3
34	70	2.2
35	42	1.3
36	60	1.9
37	4	0.1
Total	3,114	100.0 ‰

Observations — Ce tableau montre l'existence
 de deux groupes principaux de tailles:

le premier: de 15 à 21 cm.

le second: de 26 à 37 cm.

On peut noter l'absence de poissons de 22 à
 25 cm. qui doivent se tenir plus au large.
 Le premier groupe des tailles les plus petites (de 15 à
 21 cm.) est uniquement constitué par des jeunes de
S. scombrus (vrai maquereau). Ce sont les
 poissons des pêcheurs marseillais.
 Les jeunes, âgés de un à deux ans, sont im-

matures.
 Les chiffres figurant au parag. 1 nous ont
 permis de constater que ce sont eux qui, pendant le mois de
 Juin, ont fourni la majeure partie du tonnage.

Le second groupe des tailles les plus élevées (de 26 à
 37 cm.) est constitué, en proportions sensiblement
 égales, par des poissons des deux espèces: maque-
 reau (*S. scombrus*) et biar (*S. colias*). Ces
 poissons se montrent, dans l'ensemble, d'une taille
 un peu plus forte (1 à 2 cm.) que les premiers.
 Parmi ces poissons sont adultes. Agés de
 trois à quatre ans, ils se sont reproduits au moins
 une fois.

Pendant cette période allant du 15 Juin au 5
 Août, les biars sont en pleine saison de reproduc-
 tion. Les maquereaux vrais plus avancés, ont ter-
 miné leur ponte de l'année.

Nos observations nous ont montré que c'est
 dans le voisinage immédiat des côtes, même au-
 dessus des fonds de plus de 50 m. (Méjean et sur
 le "Séquent" du Planier, haut-fond de 50 m.) que
 les captures de maquereaux immatures (de 15 à
 21 cm.) sont les plus fortes.

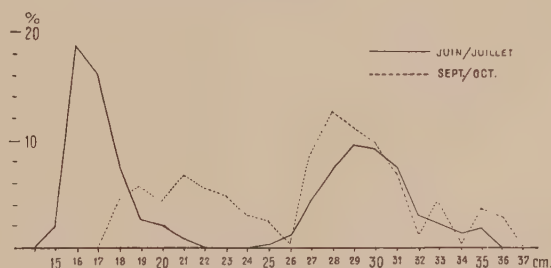


Fig. 7. Marseille.

Lieux de pêche — près de Marseille
 Engin — Lamparo (de nuit) Date — Sept.—Oct.
 Observateur — M. J. Furnest in
 Nombre d'individus mesurés: 468

Longueur totale (en cm.)	Nombre d'individus	Représentation en ‰
18	21	4.5
19	27	5.8
20	20	4.3
21	28	6.8
22	27	5.8
23	23	4.9
24	15	3.2
25	12	2.6
26	3	0.6
27	41	8.7
28	59	12.6
29	52	11.1
30	46	9.8
31	34	7.3
32	6	1.3
33	19	4.1
34	2	0.4
35	18	3.8
36	15	3.2
Total	468	100.0 ‰

Les chiffres ci-dessus indiquent que la popula-
 tion de maquereaux sur lesquels la pêche a porté
 est constituée par trois groupes d'âge principaux:

- 1) groupe de 18 à 23 cm. âgé de 2 ans environ.
- 2) groupe de 27 à 31 cm. âgé de 3 ans environ.
- 3) groupe de 33 à 36 cm. âgé de 4 ans environ.

Le premier groupe est constitué uniquement par des poissons de l'espèce *S. scombrus* L. (vrai maquereau). Tout porte à croire que ce sont les mêmes que ceux du mois de Juillet qui se classaient dans les tailles de 15 à 20 cm. Cette augmentation de taille est due à la croissance, très active jusqu'à l'automne. Ce sont des poissons immatures.

Les deux autres groupes constitués en proportions variables, par les deux espèces mélangées des adultes qui se sont déjà reproduits comme nous l'avons vu, pendant l'été.

J. Furnest

Northern North Sea.

ANNUAL REVIEW.

THE gradual improvement in conditions for the prosecution of fisheries research since the resumption of post-war sea activities was well maintained during the year under review (1947), when research vessels of five different nationalities operated within the area. Danish, English, Norwegian and Swedish vessels made periodic excursions into the area, while the Scottish vessels were continuously employed, except for the first quarter of the year, in carrying out general offshore and inshore surveys. Some co-operation has been achieved in attacking the various problems in the area but greater intensity in this direction is desirable if a quicker solution is to be found of overcoming the outstanding difficulties and explaining the annual variations.

The work centered largely on haddock and herring and ranged from a study of the environment to large analyses of the stocks of fish and the effect of the season on fishing operations. At the Council Meeting in October, papers were submitted for discussion on the effect of the war on the stocks of fish, on haddock as in nearly all other species treated, and a general conclusion was drawn that the stocks had improved on an average a threefold increase in density, as a result of the wartime partial closure allowing greater survival of the older fish.

The great development of instruments and processes for wartime purposes has raised the question of their application in peace time and thus has stimulated interest in new methods of prosecuting fisheries and of tackling scientific research. Improvements in design, power and range of fishing vessels, the use of plastics, the efficiency of radar, echo-sounding are some of the items which might be mentioned. Experiments on the lines of substitute materials have been forced upon us largely through shortage in supply of the usual material. Nylon, for example, has replaced manilla in trawl gear, nylon being too expensive. The finer apparatus for oceanographical work are practically irreplaceable but the supply position is gradually improving.

A. Environment.

The hydrographic position was conditioned by a southerly extension of boreal water which dammed back the Atlantic water in the Faroe—Shetland Channel and thus restricted its inflow into the northern North Sea for the greater part of the year. The spring influx, therefore, of Atlantic water was weak and it was not until October that evidence was forthcoming of an inflow of any magnitude. Exceptionally high surface temperatures were in operation during the summer months, especially in the north-eastern region, while abnormally low temperatures persisted throughout the year at the bottom, especially in the central area.

The plankton observations more or less broadly support the above conclusions, though there are small rather unusual infiltrations which do not upset the general trend of events. The relative scarcity of *Sagitta elegans*, an indicator of Atlantic water, is significant.

B. Fish Species.

Haddock. The catches, commercial and research, consisted almost entirely of the two year-classes, 1944 and 1945, with the younger group the more abundant. Older fish were practically negligible in the hauls of the research vessel. The brood of 1946 did not show up at all well in the hauls with small-meshed cod-ends and from more recent observations this year-class seems to have been one of the poorest recruitments on record. So far there are no indications from the fishery of a displacement of any magnitude of this year-class. The brood of the year (1947) was a little better but still well below average.

Lemon Sole. An interesting feature in the biology of this species, according to the age determinations made herein, is the large number of broods or year-classes represented in the catches at any one time and place. This seems to be the case also for megrim and witches.

The position of the stocks of lemon sole has undergone some change since the previous year. There are now relatively less of the larger and older fish and more of the younger groups, an observation which seems to be related to increased fishing activity.

Plaice. Investigations on the inshore plaice populations round the Scottish coast were renewed for comparison with conditions in pre-war days. The working up of the results is in progress.

Herring. The total commercial drift-net catch off the east coast of Scotland was considerably less than in the previous year, but this was balanced to some extent by the good trawl catches on the Fladen Ground between August and October. The number of drift-net and trawl samples was necessarily very limited, but there was distinct evidence of a lag in the cycle of events in both fisheries. For example, late autumn spawners of a southern type persisted on the drift-net grounds until the end of July and on the Fladen till the end of September, in both cases later than the normal course of events. Spring spawning herring were not prominent at any time in either fishery.

Investigations on the causes of the failure of the Firth of Forth fishery in recent years were renewed and are now being pursued energetically with the help of the new herring research vessel "Clupea".

Mackerel. The capture of post-larval mackerel is not exactly a common occurrence and it is hoped that the records included herein will be a useful

addition to the biology of the species. The distribution and the occurrence of the adolescent stages in the area may also be of some importance.

Occasional Immigrants. The recording of fishes and invertebrates in Scottish waters has been going on since the early days of the Fishery Board for Scotland, but with the cessation of recording during the war years, an attempt was then made to collect and interpret the data. The paper on page 51 including relevant notes on other exotic animals is a preliminary account on very broad lines which will be followed by a more detailed report. It is obvious that the accumulation of the occurrence of certain years must have some significance, though the actual species in the peak years may be the same but it is hoped that, eventually, the data may be helpful in elucidating the question of the causes of the fluctuations in commercial fisheries.

C. Fishing Gear.

Comparative fishing tests between the "Explorer" and "Sir Lancelot" were carried out in November and December in the Shields area off the Firth of Forth. Preliminary results indicate that the Granton pattern of trawl as used from the "Explorer" is more successful for the capture of round fish. The V.D. trawl of the "Sir Lancelot" apparently caught more flat fish but was more liable to damage on the bottom.

R. S. Clark

ENVIRONMENT.

Monthly Anomalies of the Surface Temperature in Areas of the Northern North Sea.

In an earlier article (Smed, 1947a) monthly anomalies of the surface temperature for some areas in the southern North Sea during the years 1900—1939 were given. As such anomalies may be of interest to the fishery biologist, these have now been extended for areas of the northern North Sea also. For the areas D and E (see Fig. 1) the anomalies were computed from the temperature data contained in the Hydrographical Card Index of the Council and using as basis the means for the period 1 July 1905—30. June 1914 recorded in the "Variations de la Température de l'Eau de Surface de la Mer du Nord pendant les Années 1905—1914", published in the series *Bulletin Hydrographique*, (2). As to details concerning the calculations the reader is referred to the paper cited above. The results have been arranged in two tables¹⁾ and the monthly anomalies are recorded together with the numbers of observations on which they are based. Furthermore the anomalies have been plotted in Fig. 2, so as to permit a general view of their variations.

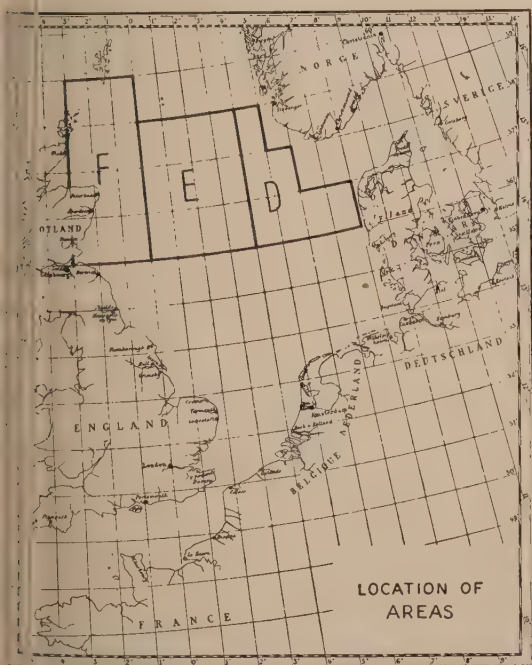


Fig. 1.

From Fig. 2 it is quite clear that the anomalies of the surface temperature are to a very high degree the same in the two areas. Another conspicuous feature is the predominance of positive anomalies in the later part of the period considered, i.e., from about 1932. Obviously the rise of surface temperature which from the beginning of the Twenties has taken place in Arctic waters has in the Thirties extended to North Sea waters also.

For the area F (see Fig. 1) it was found preferable to use for this investigation the data collected by the Danish Meteorological Office as this material for the area in question is much more extensive than the material contained in the Hydrographical Card Index. The data extend back to 1876. For the period 1876—1911 the data were kindly placed at my disposal by Helge Thomsen, Head of the Nautical Section of the Danish Meteorological Office, while for the years 1912 and onwards the data were compiled from the *Nautisk Meteorologisk Aarbog*. As grand monthly means for each 1° square over the period 1876—1915 have been published by Ryder (1917) the calculation of the monthly anomalies was based on these mean values in spite of the fact that the anomalies obtained in this way may not be fully comparable to the values found for the areas D and E. For details of the procedure in working up the data the reader is referred to an earlier paper (Smed, 1947b).

In a third table¹⁾ are given the resulting anomalies as well as the numbers of observations on which these anomalies are based. Fig. 3 is a graphical representation of the anomalies. It appears

Table 1. Monthly Anomalies ($\Delta^{\circ}\text{C}$) and Numbers (n) of Observations of the Surface Temperature in the Area F (see Fig. 1) for the years 1945—1947.

	1945		1946		1947	
	Δ	n	Δ	n	Δ	n
January	—	—	1.3	3	0.5	27
February	—	—	1.2	7	—0.5	21
March	—	—	1.5	14	—0.7	14
April	—	—	—	—	—0.5	24
May	—	—	0.7	14	0.1	21
June	—	—	0.7	8	—0.2	23
July	—	—	0.3	23	2.1	32
August	—	—	0.8	21	2.8	19
September	—	—	0.6	22	1.6	27
October	1.7	4	0.8	47	1.0	32
November	—	—	1.1	13	0.7	30
December	0.4	8	0.8	28	1.0	11

¹⁾ Not to be printed here, but kept in the archives of the Service Hydrographique of the Council from where copies may be had at request.

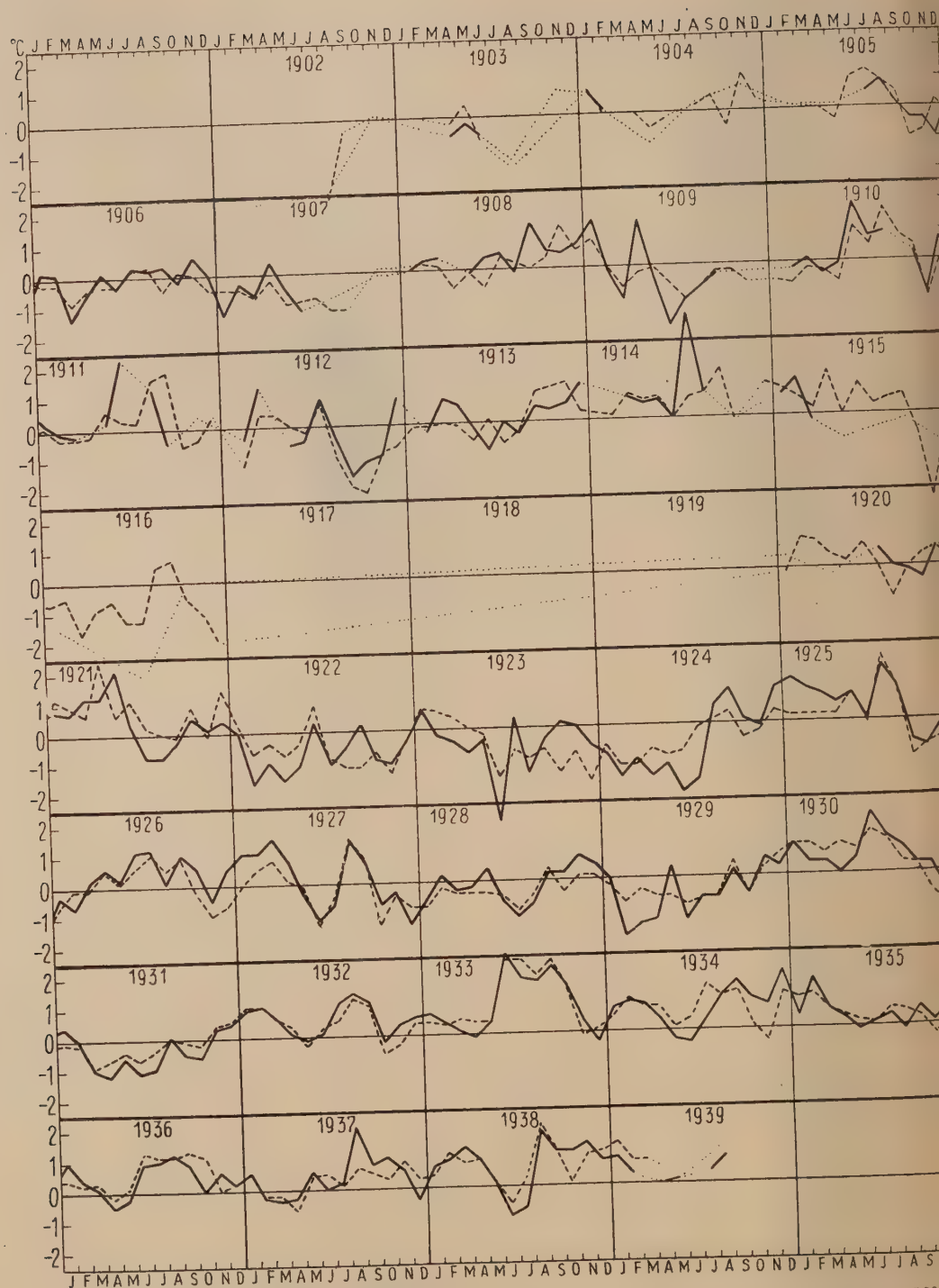


Fig. 2. Monthly anomalies of the surface temperature in the areas D and E (see Fig. 1) during the years 1902-1939.
Solid lines: area D; dashed lines area E.

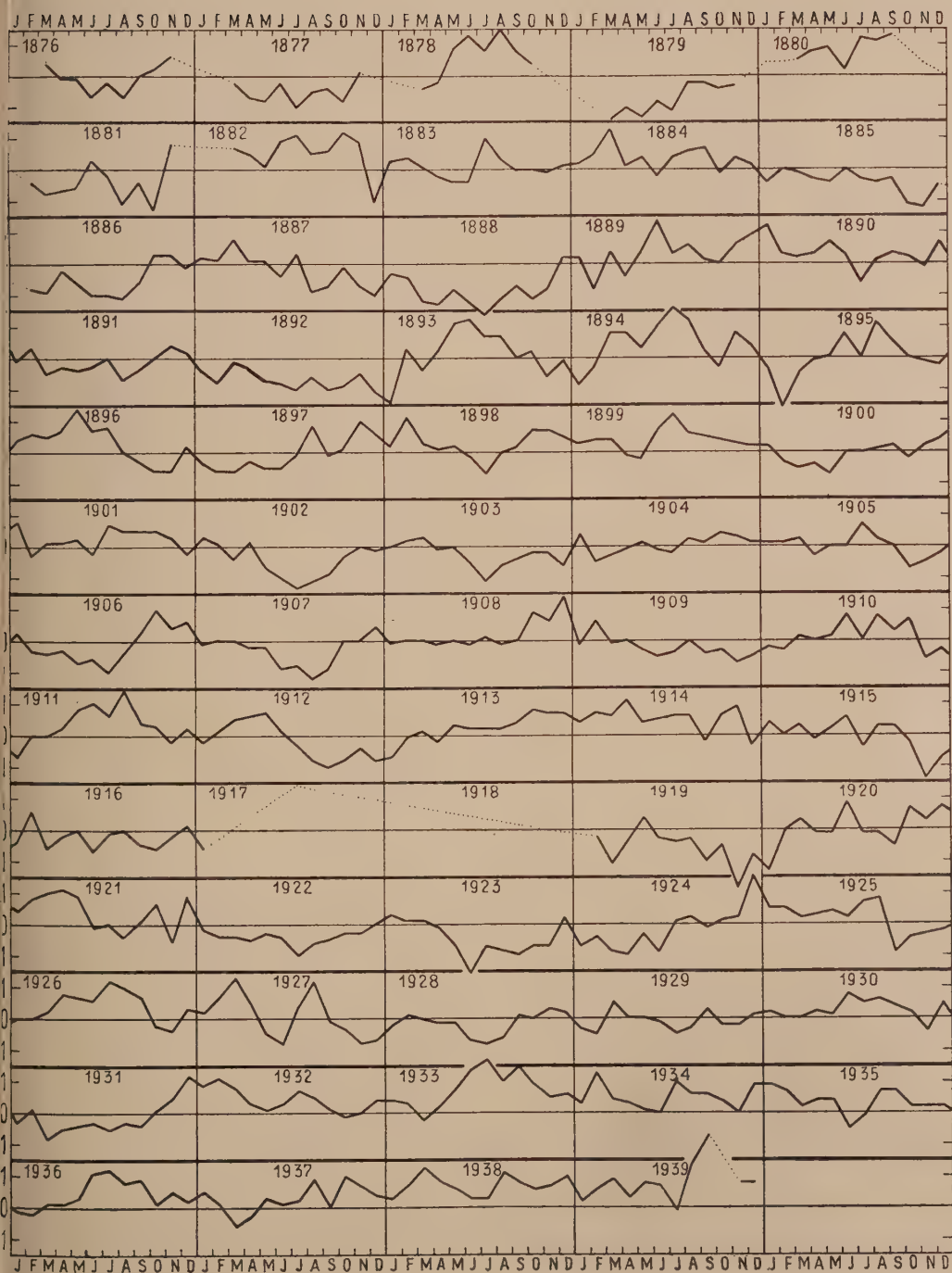


Fig. 3. Monthly anomalies of the surface temperature in the area F (see Fig. 1) during the years 1876—1939.

from the figure and from the table that also for this area the positive anomalies are predominant from about 1932.

Unfortunately no observations from the war years are at disposal. For the years after the war some data from area F have been published in *Nautisk Meteorologisk Aarbog*. On the basis of these data the anomalies recorded here in Table 1 have been found. It appears from the table that positive anomalies are still predominant.

In conclusion I want to thank Mrs. Poula Holm and Mr. P. Alnøe for the carrying out of the calculations.

Literature.

- Conseil Permanent International pour l'Exploration de la Mer. Variations de la Température de l'Eau de Surface de la Mer du Nord pendant les Années 1905—1914. (Bulletin Hydrographique, 1922).
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Ryder 1917. Monthly Mean Temperatures of the Surface Water in the Atlantic, North of 50°N. Lat. (App. to Nautisk Meteorologisk Aarbog). Copenhagen.
Smed 1947a. Annales Biologiques, Vol. II, p. 44.
Smed 1947b. Annales Biologiques, Vol. II, p. 17.

Jens Smed.

Scottish Hydrographical Investigations.

From April to December, 1947 inclusive, the Scottish research vessel "Explorer" carried out hydrographical work in central and northern parts of the North Sea, in the Faroe—Shetland Channel, and to the west of Scotland. 280 stations were occupied for surface to bottom temperature and salinity observations and, in most cases, for the launching of surface drift-bottles.

April—May.

A survey of the north-western North Sea, from latitudes 57°30'N. to 61°N., and west of longitude 1°30'E., took place between 11th April and 3rd May. Conditions were found to be markedly under average for the season. In open waters off the Aberdeenshire coast (latitude 57°30'N.), temperature was less than 4.5°C. from surface to bottom. Northward into east Shetland waters, temperatures nowhere below latitude 61°N. exceeded 7°C., and vertical homothermal conditions prevailed over the whole region.

Salinity also showed considerable negative anomaly. Oceanic water, very much diluted ($S = 35.03 \text{ ‰} - 35.08 \text{ ‰}$) was first encountered only about latitude 59°N., and thence northward, except for a small bottom patch about 30 miles south-east of Lerwick, Shetland, salinities were everywhere less than 35.20 ‰ south of latitude 61°N.

Along this latitude, halfway to Norway from the immediate north of Shetland, the uppermost 70 metres of water, except on the eastern end of the section, had a temperature of between 7°C.

and 8°C., falling to the eastward and below 60 metres, to just under 7°C. Similarly, salinity almost the entire section lay within the narrow range of only 35.24 ‰ to 35.29 ‰.

Immediately north of Shetland there occurred a small tongue, 60 metres in depth, of 35.3 ‰ oceanic water. The disposition of the isohalines, however, in the remainder of the section showed that this more saline water was impeded in its eastward and southward progress into the northern North Sea.

Evidence in support of the suggestion is derived from drift-bottle results covering the area in question. This entails reversion, first to the results of liberations carried out in the area during the last quarter of 1946. These results establish operation of a clockwise circulation embracing the entire north-western North Sea from the Moray Firth to latitude 61°N. The system obviously functioned for a long period from October 1946 onwards; for, while the majority (25) of 39 recoveries took place during the last three months of 1946, the not inconsiderable remainder of 14 recoveries, representing strandings from Moray Firth to Shetland, occurred in the months of January (2), February (5), April (2), May (1) and June (4), 1947.

Results of liberations in the area in April and early May 1947 attest the existence of this circulation. Of 290 drifters liberated, 45, in liberation-positions both to the north and south of the relevant stranding-places, beached on Shetland, Orkney, and Moray Firth shores in all five months from May to September. A further significant feature of these 1947 results is that, until the end of October, they were entirely unassociated with strandings elsewhere, either in Britain or abroad, thus arguing the complete absorption by the circulation, throughout the entire summer, of all drifters launched in the area.

In relation again to October 1946 hydrographic results it is a striking fact that, in April 1947, the north-western North Sea contained much colder water, more saline, and smaller bulk of oceanic water than was present in the same region six months previously.

Central North Sea waters, between latitude 58°N. and 58°N. and west of longitude 4°E., surveyed in the latter half of May 1947. The outstanding result of 240 drift-bottle liberations was that, until the month of October, there was no result, the drifters having been held up throughout the intervening months in the open waters of the central North Sea.

As in the north-western North Sea in the previous month, temperature and salinity distribution in the central area in May showed considerable though, in upper waters, somewhat less negative anomaly. Bottom water temperatures at substantial depths were under 6°C. over practically the whole of the region, to minima of under 4°C. — almost 3.5°C. — along the northern edge of the Lofoten Bank, were remarkably low and are reminiscent of the conditions in the same area in the winter of 1946.

ilar conditions in the spring of 1929. In connection with a decreasing bottom temperature gradient from north to south, these exceptionally low temperatures of May 1947, as well as the low salinities simultaneously recorded, point unmistakably to a strong, northerly-directed influence along the floor, of cold, continental, winter, waters. The foregoing considerations lead to the conclusion that, in the spring of 1947, the northern North Sea as a whole experienced remarkably little influence from the north projecting into the region; in other words, a remarkably weak, or more or less suspended, incursion of oceanic water. This condition endured throughout the month of June, when temperature and salinity data taken in the northernmost area at the beginning and end of the month continue to show decided subnormality. Drift-bottle results provided further evidence of the existence of the gyration which for so long evidently regulated these waters.

Thus, throughout the normal spawning season of the more important commercial fishes in the North Sea haddock in particular, physical conditions in the northern North Sea, more especially perhaps, under normal conditions, were particularly unfavourable in 1947, and almost certainly had a close bearing on the dearth of 1947 baby haddock, as also upon the circumstance that whiting were only found to spawn as late as the latter half of July. The above interpretation of hydrographical results for the northern North Sea, particularly as regards the cause of prevailing subnormal physical characteristics, appears at first sight to be at variance with temperature and salinity distributions in the two sections across the north and south respectively of the Faroe—Shetland Channel. These sections lay (i) between Shetland and Faroe and (ii) obliquely across the Wyville Thomson Ridge between Faroe Bank and the Butt of Lewis.

While maximum salinity at 35.40 ‰, representing the core of the northerly-directed Atlantic current through the Channel, was lower than any previously recorded on these same two sections in both sections, in June 1947, showed very much lower cross-sectional areas of high temperature (<11°C.), and high average salinity (>35.00 ‰), than have hitherto been encountered. In 1947, by mid-June 1947, although almost certainly some weeks prior to that, there undoubtedly was present in the Faroe—Shetland Channel a very large volume of oceanic water which was not passing in any significant amount round the north of Shetland into the North Sea, as, by previous experience, is to be expected. Explanation of this phenomenon emerges from further consideration of the above two sections in comparison with those taken in the same month in previous years, and in connection with certain drift-bottle results from the 1947 liberations in the area.

The evidence is that oceanic water was banked up in the Channel on account of a more

southerly extension than usual of the boreal waters forming part of the general circulation of the Norwegian Sea.

July—December.

The whole northern North Sea north of latitude 57°30'N. to latitude 61°N. was surveyed in the latter half of July 1947. Surface temperature anomaly was then everywhere more strongly positive than, three months before, in April, it had been negative, but the significant point in relation to the high temperatures registered in July was that it was only in the north-western corner of the region that these temperatures were associated with oceanic water of salinity greater than 34.99 ‰. The association, moreover, was with only comparatively weak oceanic water, nothing over 35.20 ‰ salinity generally less than 35.17 ‰. The high temperatures, in short, were almost certainly due to prolonged solar radiation, and not to the influx of oceanic water from the west.

In contrast to the high positive anomaly in upper water temperatures, bottom waters over almost the entire area were abnormally cold for the season. Save for the immediate easterly vicinity of Shetland, where temperatures of about 9.5°C. were recorded, and on latitude 61°N. eastward to longitude 1°E., the entire northern North Sea plateau east of longitude 1°W. lay at substantially under 7°C., a large part of the region being below 6°C.

The liberation of 490 drift-bottles during July yielded, by the end of the year, 127 returns. Only two of these were from stranding places on the west side of the North Sea. Launched within comparatively short distances of their respective stranding-places in east and west Shetland, the two bottles concerned were recovered only some two months later, in September. It is perhaps significant, despite this long interval, to observe that the west Shetland recovery originated at a position midway between Fair Isle and the northmost of the Orkney Islands.

The remainder of the returns from the month's liberations came from west Danish, Skagerrak and Norwegian shores, 60% occurring in the month of October. Earlier recoveries in August and September are for the most part accounted for by the relative proximity of the liberation-positions to the Norwegian coast. One-third of the number of these earlier North Sea Norwegian recoveries, however, originated from positions on latitude 61°N. to the west of longitude 1°E., i.e. over towards the north of Shetland, and are indicative of a slow resultant east to south-easterly drift across the northern entrance to the North Sea from the north of Shetland towards the Norwegian coast.

All considerations for the month point to only a slow circulation over the entire region during a period marked by prolonged calm and very stable, high summer, meteorological conditions. These circumstances, in their effect on water movement

in the northern North Sea, were evidently enhanced by an extraordinarily weak oceanic influx confined mainly to subsurface layers and somewhat more pronounced on the eastern than on the western side of the region.

During August, in the southern part of the north-western North Sea, i.e., below the latitude of Fair Isle, positive surface temperature anomaly and negative salinity anomaly were recorded. On two sections, (i) from North Ronaldsay, Orkney, north-westwards into mid-Faroe—Shetland Channel waters, and (ii) from the latter southward to Cape Wrath, high temperatures to 15.68°C. were registered in the upper water layers. Only a little way to the north-west of Orkney, negative salinity anomaly gave way to appreciable positive anomaly in the waters of the Atlantic current, of which the salinity distribution again gave evidence, as in June, of the presence in very considerable bulk.

Drift-bottle results to the end of the year included a number of recoveries in late September and October on the Outer Hebrides and Orkney from liberations to the west of Scotland. Besides these, the only other records are of high latitude Norwegian recoveries in October, November and December, and, from north-western North Sea liberations, a single Skagerak recovery in December and two North Sea Norwegian strandings in November.

From the 12th to the 29th of September inclusive, the central North Sea was surveyed over practically the same routes as in the month of May. By contrast, in open sea waters towards the Ling Bank region, upper water temperatures in excess of 16°C. showed positive anomaly of almost 4°C. Elsewhere to the south and west, this anomaly declined fairly rapidly to under 2°C. and, near to the Scottish west coast to under 0.5°C.

Bottom water temperatures, on the other hand, in the eastern half of the area, east of the prime meridian, showed very little change from the May figures. The greater part of this area still lay at under 6°C.: Bottom temperatures of under 5°C.—3.98°C. at one station — were still being recorded along the northern edge of the Dogger Bank.

West of the prime meridian, towards the Scottish coast, bottom temperatures rose rapidly to upwards of 11.5°C. and at one point off the Firth of Forth estuary to over 12.5°C. between latitudes 56°N. and 57°30'N.

Salinity over the whole region was abnormally low. Oceanic water of salinity 35.00 ‰ or over was entirely absent even from the northmost stations in the Ling Bank neighbourhood, where maximum values scarcely exceeding 34.79 ‰ were common, save on the bottom, which showed the low temperature water (<6°C.) to have the highest salinity (34.90 ‰ to 34.98 ‰) in the vicinity. The lowest temperature bottom waters (<5°C.) along the north of the Dogger Bank, had a salinity of 34.65 ‰, while those of highest temperature (10.64°C. to 12.55°C.) off the east coast of Scot-

land were associated with a salinity under 34.50 ‰.

Drift-bottle results for the month comprise now familiar crop of October to December Skagerak and Norwegian recoveries, principally the former. A significant number of records indicate speeds of from 8 to over 10 miles per day, which carry the implication of an acceleration of the northern North Sea circulation as a whole from about the middle of August, when certain July records indicated speeds of about 5 miles per day, and the latter half of September.

The implication is strikingly amplified by the results of a survey of the north-western North Sea carried out between the 17th of October and November. There was then, especially north of latitude 59°30'N., a much greater volume of oceanic water in the area than was present in July, and this water was of higher average salinity in October, indicating less dilution than three months before.

The interpretation of these findings is that the withdrawal of the "barrier" earlier in the year across its mouth by northerly-derived influences, and there was a release from the Faroe—Shetland Channel region of oceanic waters which had pent up there throughout the summer. As a supporting point to this argument, there occurred between the 26th October and 15th November, the remarkable quick passage of a drift-bottle from about 10 miles north of the northmost point of Shetland to the Norwegian coast in approximately latitude 61°N. On a direct course this drifter can have travelled at an average speed of not less than 13 miles per day, which, by previous experience in the analysis of drift-bottle records, is reminiscent rather of speeds of drift-velocities when the intensity of the oceanic current in these waters is normally about its maximum for the year. At least one other drift-bottle record of the October 1947 liberations, from a position farther eastward on latitude 61°N., corroborates the deduction of high average velocity of the order of ten to thirteen or more miles per day during October and November in the waters of the Atlantic current from the Faroe—Shetland Channel.

Before passing from the October drift-bottle results, note may be made of two recoveries in November on west Shetland shores, of drift-bottles which originated respectively (i) on latitude 57°30'N. within five miles of Fair Isle, and (ii) on the way between Fair Isle and the southmost point of Shetland. These, along with other records of a similar character from the year's liberations, appear effectively to demonstrate, in conjunction with temperature and especially salinity distributions in the western and eastern vicinities of the said passages, the non-access to the North Sea proper by way of the passages between Shetland and the Scottish mainland, of oceanic water of salinity >34.99 ‰ from the west.

Towards the end of November, a few observations were made in the central North Sea

of the prime meridian. Temperatures were still high for the season, the homothermal conditions characteristic of late autumn prevailing. In regard to salinity practically no difference obtained as between surface and bottom waters. Actual salinity values were on the whole up and indeed slightly over, average figures, a condition which was to be expected from the above interpretation of hydrographic events in the previous month. No drift-bottle results were available at the end of 1947.

Observations in December were confined to the Firth of Forth estuary and contribute nothing to the hydrographic picture of the more open waters of the central and northern areas of the North Sea 1947.

John B. Tait.

Results on Continuous Plankton Records at various depths in the North Sea and North- Western Atlantic during 1946—1947.

Material and Methods.

This material was collected whilst re-organising the Continuous Plankton Recorder Survey after the war. The survey recommenced in January, 1946, and is being gradually extended, so that comparison between 1946 and 1947 and the pre-war years is necessarily tentative and incomplete. This account is prepared from the detailed work of my colleagues in the department's laboratories at Hull and

Leith, to whom I am indebted. It will only outline some obvious changes; more detailed consideration is proceeding, and must await publication in the *Hull Bulletins of Marine Ecology*.

The Continuous Plankton Recorder has already been described (*Hull Bull.*, Nos. 1 and 7). The data were obtained by continuous sampling at 10 metres depth, and this limitation in depth must always be borne in mind.

Not all the pre-war routes have yet been re-established (for example, there is no ship yet available on the important Pentland—Bergen route), although some new routes have been added. The approximate positions of those now in regular use are shown in Fig. 4, as continuous lines, with some projected additions as broken lines. Table 2 shows,

Table 2.
Table of Continuous Plankton Records.

Month	Route						
	Hull— Copenhagen	Leith— Copenhagen	Aberdeen— Lerwick	Pentland— Iceland	Hull— Rotterdam	Hull— Hamburg	Other Routes ¹⁾
1946							
January	1	—	—	—	—	—	—
February	1	1	—	—	—	—	—
March	2	1	—	—	—	—	—
April	2	1	—	—	—	—	—
May	—	2	—	—	—	—	—
June	1	1	2	1	—	—	—
July	1	2	1	1	—	—	—
August	1	1	2	1	—	—	—
September	2	1	2	1	2	—	—
October	1	2	2	1	2	2	—
November	1	2	1	1	1	—	—
December	1	2	1	—	1	—	—
1947							
January	1	1	1	1	1	1	3
February	—	1	1	1	—	1	—
March	1	1	2	1	1	—	—
April	—	—	2	—	2	—	—
May	2	—	1	1	2	1	—
June	1	1	2	—	2	1	1
July	1	1	4	1	6	—	—
August	1	2	2	—	6	—	1
September	1	1	2	1	4	1	6
October	1	1	1	—	2	1	1
November	1	1	1	1	2	1	5
December	1	1	1	1	1	—	3

¹⁾ Other routes include Leith—Lerwick via Kirkwall (August, September, October, 1947), Newcastle—Copenhagen (November, December, 1947), London—Stockholm (November, December, 1947), north of Ireland to the southern one of the two British Weather Ship stations (November, December, 1947), and various irregular routes. A further route, to the northern one of the two British Weather Ship Stations, was opened in January, 1948.



Fig. 4. Continuous Plankton Recorder Survey, 1946—47.

now available are denoted by continuous lines, whilst projected routes are denoted by broken lines.

in conjunction with Fig. 4, the records available in each month. Usually they were complete records, but a small number were short owing to heavy weather, etc. They total some 31,000 miles.

North Sea, 1938—1939.

The 1938—1939 data have either been published (Bulletins 8, 9, and 12 for the phytoplankton, and 11 and 13 for the zooplankton), or are now in the press (Bulletin 14 and 15 for the young fish, fisheggs and the copepod *Calanus*). They show the planktonic variations in monthly detail and provide a basis for comparison with subsequent years.

North Sea, 1946—1947.

Quite the most significant feature of 1946—47 is that the overall pattern of the plankton distribution, and its changes, were fundamentally similar to those observed in 1938—39. This is important since it implies that there is a consistent annual trend, essentially that outlined by Russell (1939), with detailed annual variations arising from the movements of organisms and their success or failure.

The 1946 data were particularly inadequate in the south, but the 1947 southern phytoplankton crop was undoubtedly scarcer than in 1938 and, as far as the evidence goes, this possibly applied to 1946; in this, at least, there was more resemblance to 1939 than to 1938. The southern patches of both *Biddulphia sinensis* and *Rhizosolenia styliformis* were thinner in 1947 than in 1938, which, in turn, was by no means one of the richest pre-war years for these species. So considerable was the dinoflagellate reduction, that the southern numbers more closely approached those of 1933 (Bull. No. 3) than any other year for which we have records; they were also relatively scarce in the north. *Phaeocystis* appears to have been scarce in the north-west in both years. In the south-east, on the other hand, it was probably of at least average density in 1947, whilst decidedly restricted to the extreme south-eastern part of the area as in 1933 and 1939 (Bull. Nos. 3 and 9).

The 1946 summer copepods were rather scarcer in the centre than in 1938, and much scarcer in the north, although they were more abundant in the south during the autumn. The 1947 summer copepods were even scarcer in the north, but the central and particularly the southern numbers in 1947 were quite the highest for these regions, and at times the southern patches were dominant in the autumn. For the extreme south this abundance was such as once again to resemble the conditions of 1933 (Bull. No. 4).

The north-western population of *Calanus* in both 1946 and 1947 was smaller than that of 1938, and thus rather resembled 1939. In contrast num-

bers were unusually large in the west central Sea and further south. This applies also to pods such as *Pseudocalanus*, *Temora*, and *Acartia*, although each had its individual differences.

The young clupeoids recorded in the north-western coastal waters were probably scarcer in 1946 and 1947 than in 1938—39 up to mid-August, but they were much more abundant than in 1938 (there were no data for 1939). Whilst those in 1947 were not quite so dense, the concentrations found in 1946, from the Moray Firth to Fife Firth, were several times greater than those in 1938 over the same period, and were denser than any we have previously found elsewhere in the North Sea. It will, therefore, be interesting to observe the proportions of young herring in the appropriate shoals of 1949—50.

Except for moderate numbers of clupeoids in the Southern Bight from January to March, and in July, the central and southern stocks did not show any major variations. For the non-clupeoid fish, there is little doubt that the numbers in 1946—47 were generally lower than in 1938, although they were rather more successful in August in the north-west.

Of the "Indicator" species, the Metridiidae *Candacia* patches in 1946—47 were relatively fewer in the north-west, and appeared later, though they were either scarce or absent off the Humber. *Limacina* and *Clione* were proportionately even more abundant at 10 metres. In contrast, whilst *Sagitta elegans* was scarcer at first, *Sagitta elegans* developed higher north-western numbers after August in 1946 than in 1938—39, whilst its subsequent extension to the south was in very much greater numbers, so that it became widespread in the central and southern waters at 10 m. by February 1947. The northern increase of 1947 was again relatively poor in August, but thereafter it also exceeded 1938, the period of low numbers being associated with the appearance of *Sagitta setosa* in the north-west, though its numbers were quite low in 1946, *Sagitta setosa* was not only abundant in the north (as were other euphausiids), but it appeared far south as the Humber mouth. In association with this we recorded more *Rhincalanus* in both years before the war.

Labidocera wollastoni and *Isias clavipes* were each scarcer in the central waters in 1946 and 1947, and more abundant off the Humber and East Angles, thus recalling the conditions of 1932 (Bull. No. 4). *Sagitta setosa* was unusually abundant in 1946—47, even extending into the Orkney—Shetland area in 1947, whilst its numbers in the Southern Bight were the biggest we have recorded since 1932—33 (Bull. No. 6).

The absence of the Pentland—Bergen line of vents effective comparison for the north-eastern forms, but the "Indicators" of the southern region showed significant changes. *Corycaeus angulatus* and *Phthisica acaudata* were both more abun-

1946 than in 1947 or 1938, whilst a few *Corydella* were recorded well to the north-west of the pre-war area in both 1946 and 1947. *Phthisica caudata* was so abundant in the Southern Bight in the winter of 1946—47 as to recall the previous winter of 1932—33 (Bull. No. 6). Although not limited to that area, *Centropages typicus* was recorded there in 1947 in the highest numbers of 1932—33 (Bull. No. 4), whilst *Biddulphia* was had not been so scarce there in our records of the same period (Bull. No. 3).

North-Eastern Atlantic.

Before the war, and since, records were normally obtained from the north-west coast of Scotland to the Bailey Bank for various distances towards the Faroe, but there were three exceptional routes to Orkney north-east of Faroe to the east coast of Iceland. The series is somewhat irregular, the earlier records being obtained from April to August 1939, whilst those after the war were started in July, 1946; not more than one month was missed at any time except for the period August to October, 1947.

It is now possible to review the most important features of the annual cycle at 10 metres in the waters. As was shown in 1938 (Bull. No. 10), the route can be divided into (a) a narrow stretch of the coastal banks, (b) the channel extending from the Bailey—Faroe Bank, and (c) the deep waters and those banks. At times the Bailey Bank and, particularly, the waters off Faroe may be added as a fourth region. The results for 1946 and 1947 may be summarised as follows:

A distinctly oceanic fauna was found in July and August between the Hebrides and Iceland, characterised by *Thysanoessa longicaudata*, *Themisto compressa*, *Clio* spp. and *Clione* spp. to the south of the Bailey—Faroe Bank, and by a rich benthic community including *Metridia lucens*, with *Meganyctiphanes norvegica*, *Dolioletta gegenbauri*, various jellyfish, over the Channel. Dinoflagellates (mainly forms of *C. fusus*), with various Radiolaria, were also present in July, but *Limacina* reached high numbers near the mainland in August. The numbers of *Meganyctiphanes norvegica* were larger in 1946, whilst the Thaliacea were fewer, but otherwise the communities were very similar to those found in 1939. The Thaliacea had disappeared by September, but the numbers of *Clio* were diminishing and the phytoplankton was also relatively scarce. *Meganyctiphanes norvegica*, however, had increased and appeared to extend from the Hebrides in September, in association with *Metridia lucens*, *Euchiroa norvegica* and *Pleuromamma robusta*, to Faroe in October where it was mixed with large numbers of *Calanus* and *Thysanoessa inermis*. Over the

deeper water *Meganyctiphanes norvegica* was replaced by *Thysanoessa longicaudata* (with *Euchaeta norvegica*), whilst it gave place to *Nyctiphanes couchii* nearer the mainland, where *Limacina* was still abundant in September and *Sagitta elegans* in October.

Most forms had decreased by November and then became scarce or absent until May, 1947. Such as were recorded, however, retained the generalized distribution outlined above. *Sagitta elegans* was still common over the coastal banks (with *Clione limacina*) in November, and *Eukrohnia hamata* was recorded off the south-west coast of Iceland in February, 1947. No significant growth of diatoms had been recorded by March, 1947, although they were widespread (particularly to the north of Faroe) in May, when *Calanus* was the dominant feature of the plankton from Shetland to Faroe.

The distribution in July 1947 broadly resembled that of 1946, although this time *Dolioletta gegenbauri* was much more abundant and widespread (thus more resembling 1939), as also were the euphausiids. Salps, however, were not recorded. In this month, too, the greatest concentration of doliolids was over the deeper waters, along with *Thysanoessa longicaudata* and *Tomopteris*. *Ceratium fusus* was again the dominant dinoflagellate, but the diatoms were much scarcer than in 1946. There was no August record and only an incomplete one in September when doliolids were still present. *Limacina* appears to have been much scarcer this year, as also was *Sagitta elegans* in November.

A striking feature of the November record in 1947 was a relative abundance of phytoplankton, the concentrations of dinoflagellates then being the densest recorded by us during the three years. Various other forms, including *Limacina* and several copepods, were also very widespread and abundant, whilst *Clione* was present over coastal banks.

The numbers of most forms had decreased considerably by December, although *Pleuromamma robusta* was still relatively common, both in the Channel and over the deeper water.

It is possible that the relative richness of the autumnal plankton is to be associated with the unusual high temperatures of 1947. This richness is confirmed by the data from the first records collected by the British Weather Ships sailing to and from their stations to the south of Iceland in November and December. They, too, show a distinct division between the coastal fauna and flora and the deeper. Whilst the deeper waters have a number of features in common with those of the Iceland line, they also had their own typical forms. It is hoped in 1948 to trace the connections between these three lines and to observe the spreading and narrowing of the oceanic water, if possible connecting all these with neighbouring events in the North Sea.

General.

The most striking feature is most certainly the evidence of several resemblances between the post-war years and the period 1932—34 in the Southern Bight, and particularly between the winter of 1946—47 and the winter of 1932—33. On other grounds we now believe 1933 to have been a year of fairly strong Atlantic influence in the North Sea, and it was unusually warm that year. As yet, no hydrological information has been published, but we know that 1947 was also an unusually warm year, and it may well prove that oceanic influences were also unusual then, as might be suggested by the relatively rich planktonic development, particularly in the later months, in the north-eastern Atlantic.

References.

- Russell, F. S. 1939. "Hydrographical and Biological Conditions in the North Sea as Indicated by Plankton Organisms". Journ. du Cons., XIV, 2, pp. 171—192.
Hull Bulletins of Marine Ecology, 1—13 (also 14 and 15 now in the press).

C. E. Lucas.

Plankton Investigations from the Scottish Research Vessel.

Plankton collections were taken by the Scottish research vessel "Explorer" from April to December 1947, and in working up the samples, emphasis has been placed on the distribution of the indicator species and on the young fish populations. Anomalies in the distribution of the indicator species in 1947 were found as early as April and the first week of May when *Sagitta serratodentata* was found between Fair Isle and Orkney, and also at four other stations within 100 miles south and south-east of this position. No specimens were found north of Fair Isle, east or north-east of Shetland. With the *S. serratodentata* were *Pareuchaeta norvegica* and *Rhincalanus*. The oceanic species found north-east of Shetland in April were *Physophora hydrostatica* and *Pleuromamma robusta*.

A single specimen of the copepod *Corina granulosa*, Giesbrecht, believed to be the first Scottish record, was taken at 61°01'N. 0°00'. A patch of *Halosphaera* extended over the area east of Shetland and *Calanus finmarchicus* with *Pseudocalanus minutus* occurred over most of this area, being especially common in the region of Fair Isle.

The May investigations into the central North Sea area showed that *Sagitta elegans* was less common than usual whereas *S. setosa* was very abundant indeed and was accompanied by *Aglantha digitalis* var. *rosea*. Associated with the *S. elegans* community were vast numbers of the medusae *Eutonia indicans*, especially off the Firth of Forth, and smaller numbers of *Sarsia tubulosa*, *Cyanea capil-*

lata, *Staurophora mertensii* and *Mitrocomella diademata*.

The patch of *Halosphaera* found east of land in April had extended as far south as the eastern part of the Moray Firth and a dense of almost pure *Chaetoceras borealis* was present in the Fladen area. *Calanus finmarchicus* and *Pseudocalanus minutus* were common in the S. community, and especially common to the north of the Moray Firth where collections were rich and very oily.

In June *Cosmetira pilosella* and *Evadne armata* were found at both sides of the Pentlands Firth and in the northern and central areas of the Moray Firth, but there is no evidence available for the north of Orkney at this time. *Cosmetira* was, however, found north-west of Shetland in June, and in July west and south-west of Fair Isle and north-east of Shetland.

During June the "Explorer" traversed the Firth of Shetland Channel (see NW. Area Report) cutting across the region of main Atlantic influence and sampling the stock from which oceanic plankton penetrating into the northern North Sea may have been expected to originate. This included the following species:—*Laodicea undulata*, *Cosmetira pilosella*, *Sagitta serratodentata*, *S. lychnodonta*, *Eukrohnia hamata*, *Chelophyes appendiculata*, *Physophora hydrostatica*, *Rhincalanus minutus*, *Eucalanus elongatus*, *Calanus hyperboreus*, *Pareuchaeta norvegica*, *Pleuromamma robusta*, *Gastrea arctica*, *Thysanoessa longicaudata*, *Uca*, *pyramidata*, *Meganctiphanes norvegica*, *Doliolum*, *gegenbaui* and larvae of scopelid fish. From the line of stations sampled eastwards from Flugga, latitude 61°01'N. in July, not a single specimen of any of the major indicator species found in the Faroe Channel was recorded west of 3°E. but sparsely scattered individuals of the most cosmopolitan oceanic species such as *Laodicea*, *Cosmetira*, *Meganctiphanes*. East of 3°E. a few specimens of *Chelophyes appendiculata*, *Clio pyramidata*, *Thysanoessa longicaudata* and *Myctophum* sp. were found, which would appear to indicate a linkage between that area and the Faroe Channel, although there is no planktonic evidence to suggest that the oceanic water was more than impinging there. The record over the Norwegian Deep (200-metre contour) sampled in July contained the usual population of *Calanus hyperboreus* and *Pareuchaeta norvegica* with *Thysanoessa longicaudata* and *Euchirella strata*.

Indigenous North Sea plankton, dominated by *S. setosa*, flooded most of the central and northern western area of the North Sea and a tongue extended northwards at least as far as 61°N. about 1°E. in July. It extended, together with *Obelia* medusae, westwards to the immediate north of Fair Isle, but not further in that region, demonstrating the discontinuity of water masses at the side of the Fair Isle—Sumburgh passage.

Calanus was found west and north-west of Fair Isle but not to the north or north-east is further supporting evidence on this point. Rhincalanus was never found in the Fair Isle—Orkney passage but about 30 miles SE. of Orkney in July. By August Rhincalanus had penetrated some 60 miles by September about 100—150 miles SE. of Orkney into the northern North Sea.

To the north of the Fladen a patch of phytoplankton, dominated by *Coscinodiscus concinnus* and *Ceratium macroceros* was found and to the north of this patch *Limacina retroversa* was very abundant. *Uca finmarchicus* was not generally abundant, but in May, was more so in the area of *S. setosa* than in the area of *S. setosa*. Calanus, especially over the Norwegian Deep, had a heavy concentration of *Ellipsoidea* sp. A small proportion of Calanus found in the northern stations was *Uca helgolandicus*.

The September investigations covered an area similar to that of May. *S. elegans* was still scarce. *S. setosa* very abundant, and this together with medusae present, demonstrates the continued entry of Atlantic water in the central North Sea. Nevertheless, doliolids were found in small numbers at several stations scattered throughout the area in September, October and even in No-

vember, and Rhincalanus was also taken off the northern English coast in November.

A single larval Fierasfer was taken in the east side of the Orkney passage — 59°25'N. 2°04'W. in October.

An examination of the line of stations east of Shetland in October showed definite evidence of an oceanic incursion there which had been absent in July. It included *Fritillaria borealis*, *Agalmopsis elegans*, *Lensia concoides*, *Sagitta serratodentata* and *Doliolletta gegenbauri*, and these species had penetrated as far as 60°N. to the east of Shetland. *Limacina* was fairly common in the whole of the area examined.

As in previous years the richest crustacean plankton (including Copepoda and Decapoda larvae, Euphausiacea, etc.) and greatest abundance of young fish were associated with the *S. elegans* community in the north-western North Sea. The scarcity of crustacea, especially of decapod larvae, where *S. setosa* dominated was very marked indeed, and this community covered a large area of central North Sea. *Nyctiphanes couchii* was present with *S. setosa*, but the dominant and more abundant species with *S. elegans* were *Thysanoessa inermis*, *T. raschii*, with some *Meganyctiphanes norvegica*.

J. H. Fraser.

THE FISH.

Spawning and Larvae.

Annual Brood Values of Fish Larvae.

For the purpose of assessing the brood values of larval fish taken by the Scottish research vessel "Porpoise", the numbers of major commercial and minor fish larvae have been reduced to the average number per station for each of the three periods: March, April, May; June, July, August; and September, October, November, December. This then gives a series of figures which can be used as a basis for comparison with figures from other years. A comparison must, however, be made with reservations because of errors from various causes. The area investigated and the number of stations in a given area are not the same in consecutive years, and some areas are more productive of fish larvae than others. The larvae have been taken in nets 1 metre in diameter, towed for 15 minutes horizontally at a steady speed, usually at surface, 50 metres, and 100 metres depth, or at surface, midwater and bottom at stations less than 100 metres in depth. Sometimes, e.g., over the surface water of the Faroe Channel nets were streamed at the surface, 75 and 150 metres. The nets were made of cheese-cloth prior to the war period but in 1946—47 stramin has been used through which small fish might more easily escape, but the

nets will have a greater co-efficient of filtration. By averaging for a sufficiently long period over diverse areas such errors tend to be smoothed out, and it is thought that, in spite of the seriousness of these errors, the resulting figures do give at least an indication of the relative value of the larvae population from one year to another.

Figures for 1938, 1939, 1946 and 1947 have now been worked out on this principle (see Table 3) and it is hoped to continue the series in future. Owing to the cessation of investigations during hostilities there are no figures available from September 1939 until June 1946.

It would appear that the prospects for 1947 haddock larvae are less than for the 1938 or 1939 broods, neither of which was large. During the June, July, August period haddock were still represented in the plankton, although they had largely ceased to be planktonic at this stage in previous years except 1939. Sizes of larval fish in 1939 were small compared with corresponding sizes at the same time of year in previous years, giving the impression that the larval haddock population, and that many of the other spring-spawned fish, e.g., saithe and whiting, was a whole month later than usual in development. Cod, dab, witch, mackerel had fairly good larval broods, but most of the

Table 3. Comparative Brood Assessment Values Larval Fish from 1938—1947

Species	March, April, May			June, July, August				Septbr., Oct., Nov.	
	1938	1939	1947	1938	1939	1946	1947	1938	1946
<i>Gadus callarias</i>	0.98	13.65	10.53	0.02	0.38	0	1.90	0	0
<i>G. aeglefinus</i>	26.90	8.62	2.76	0.78	1.80	0.02	1.71	0	0
<i>G. virens</i>	28.24	38.16	9.29	0.10	0.24	0	0.46	0.01	0
<i>G. merlangus</i>	9.30	7.26	1.25	0.31	2.75	0.75	1.94	0	0.07
<i>G. minutus</i> }	39.64	12.98	18.80	0.26	2.09	0.05	1.86	0.01	0
<i>G. esmarkii</i> }									
<i>G. poutassou</i>	0.03	76.02	0	0	0.11	0	0.38	0	0
Merluccius	0	0.01	0	0	0.05	0.83	0.08	0.34	2.45
Molva spp.	0.03	1.86	0	0.11	1.41	0.33	0.49	0.12	0
Onos spp.	0.81	27.98	0	2.44	4.00	0.97	1.01	2.50	2.28
Other gadoids	0.34	0.97	0.13	0.05	0.15	0.07	1.01	0.01	0
<i>Pleuronectes platessa</i>	0.09	2.50	0.78	0	0	0	0.02	0	0
<i>P. limanda</i>	1.73	2.98	4.72	0.11	2.48	0.16	1.01	0.70	0.56
<i>P. cynoglossus</i>	2.17	0.50	1.27	1.47	3.29	0.22	2.09	0.77	0.73
<i>P. microcephalus</i>	0	6.94	0.06	1.97	8.82	1.33	3.29	1.04	4.22
Other flat fish	4.92	9.49	7.58	0.57	2.41	0.50	3.46	0.31	0.18
Clupeoidea	289.11	64.82	46.49	0	1.21	25.27	1.51	134.73	104.79
Trigla spp.	0.17	1.45	0	1.34	1.33	0.77	0.26	0.56	1.38
Ammodytes spp.	125.09	25.37	14.80	25.05	27.94	14.38	3.51	4.44	1.75
Gobius spp.	0.33	0.94	0	8.07	14.06	1.50	0.93	6.16	13.01
Fierasfer spp.	0	0	0	0.05	0.03	0	0.03	0.09	0
Scopelidae	0	5.18	0	0.31	1.56	0.47	2.61	0.02	0.38
Other fish	2.85	8.70	0.78	9.36	18.25	3.86	5.43	6.05	4.07

other fish, including sandeels and gobies etc. were below average in 1947.

The assessment of 1947 spring-spawned larval clupeoids was only about a sixth of that for 1938, but was comparable with that of 1939, and the figure for the autumn-spawned larvae was also much less than that for 1938 — about half — but was comparable with that for 1946.

J. H. Fraser.

List of Rare Exotic Species found in the Plankton by the Scottish Vessel "Explorer" in 1947.

This list excludes commonly occurring exotic species even although they may be of very great value as "indicators"; it also excludes species occurring rarely in 1947 but which have been found commonly in other years.

	Position		Date
	N. Lat.	W. Long.	
Siphonophora:			
<i>Lensia concoidea</i>	60°12'	7°40'	18.6
	60°02'	1°30'1)	27.10
<i>Galettia australis</i>	59°54'	4°32'	15.8
	60°15'	6°00'	15.8

1) E. Long.

	Position	
	N. Lat.	W. Long.
Medusae:		
<i>Halopsis ocellata</i>	59°31'	7°05'
Copepoda:		
<i>Corina granulosa</i>	61°01'	0°00'
<i>Augaptilus megalaurus</i>	59°44'	7°15'
<i>Phaenna spinifera</i>	60°08'	5°32'
<i>Calanus gracilis</i>	56°50'	9°30'
<i>Scottocalanus securifrons</i>	"	"
<i>Undeuchaeta plumosa</i>	"	"
<i>Undeuchaeta major</i>	"	"
<i>Euchirella curticaudata</i>	"	"
<i>Pleuromamma xiphias</i>	"	"
<i>Haploptilus validus</i>	"	"
Ostracoda:		
<i>Conchoecia daphnoides</i>	56°50'	9°30'
<i>Conchoecia obtusata</i>	61°14'	2°40'
	60°12'	7°40'
	59°56'	7°27'
	59°44'	7°15'
	59°31'	7°05'
<i>Conchoecia elegans</i>	60°12'	7°40'
	59°50'	7°27'
	59°44'	7°15'
Amphipoda:		
<i>Brachyscelus cruscolum</i>	59°54'	4°32'

N. North Sea
Fish Larvae, Haddock

	Position		Date
	N. Lat.	W. Long.	
Pododa:			
<i>Macris trispinosa</i>	59°17'	6°53'	19.6
	59°54'	4°32'	15.8
	59°48'	5°44'	16.8
	59°21'	5°28'	16.8
<i>io cuspidata</i>	59°21'	5°28'	16.8
	56°50'	9°30'	24.8
al Fish:			
<i>unsenia groenlandica</i>	60°12'	7°40'	18.6
	59°31'	7°05'	19.6
<i>tralepis coregonoides</i>	59°56'	7°27'	19.6
<i>orealis</i>	59°17'	6°53'	19.6
	59°00'	6°40'	19.6
	56°50'	9°30'	24.8
<i>thylagus benedictii</i>	60°12'	7°40'	18.6
	59°31'	7°05'	19.6
	59°17'	6°53'	19.6
	59°54'	4°32'	15.8
	56°50'	9°30'	24.8
	59°44'	7°15'	19.6
<i>omias boia</i>	59°31'	7°05'	19.6
	59°17'	6°53'	19.6
<i>erasfer sp.</i>	59°39'	3°33'	14.8
	59°21'	5°28'	16.8
	59°25'	2°04'	18.10

J. H. Fraser.

Haddock.

This paper deals with data collected by the research vessel "Explorer" from April to December 1947. During this period 145 hauls, each of one hour duration, were carried out with the covered trawl, from which all haddock were measured and scale samples taken for subsequent age determination.

The survey was concentrated within the western portion of the North Sea, between the Scottish and land east coasts and the 100-fathom contour of

the Norwegian Deep. It failed to cover the grounds to the west of the Shetlands and the area to the east of longitude 5°E. and south of latitude 58°N. Also, since researches did not commence until April, no sampling of the main haddock spawning concentrations was effected. The whole region covered has been divided into six areas, whose limits and intensity of sampling are given below.

		Limits (Statistical Squares)	Number of Hauls
Shetlands	A—D:	18—21	18
Orkneys	A—B:	16—17	3
Moray Firth	A—B:	14—15	6
Northern Area			
(excluding Shetland Area)	C—H:	14—21	52
Central Area	A—H:	8—14	49
West Coast	All grounds W. of 4°W.		17

Age Analysis of the Catches.

The number of each age-group, omitting the newly-spawned 1947 brood, present in the catches from the above areas, are given in Table 4. The figures for each region refer to the average for all the hauls taken throughout the period, and are expressed as the numbers per 10 hours' fishing.

The catches from the region shown in the table, whilst revealing wide fluctuations in the density of any one year brood, were composed mainly of fish spawned in 1945 and 1944. These two broods constituted approximately 95 % of the total catch from the North Sea. Fish older than four years of age were very poorly represented throughout the whole area surveyed. Their greatest density was in the deep water to the east of the Shetlands, but here the concentrations were small compared with the younger broods. The density of all age-groups, but especially of two-year-old fish, was much less in the central area than on the more northerly grounds. Compared with the 1946 survey, the 1945 brood

Table 4.
Age Composition of Haddock per 10 hours from North Sea in 1947.

Year	Age	Shetlands 18 Hauls	Orkneys 3 Hauls	Moray Firth 6 Hauls	Northern Area 52 Hauls	Central Area 49 Hauls	West Coast 17 Hauls	North Sea ex. W. Coast 128 Hauls
1946	1+	58	3.3	25	28	14	0	24
1945	2+	1622	2033	1510	1499	593	497	1184
1944	3+	403	367	430	259	74	197	220
1943	4+	72	57	70	51	18	57	42
1942	5+	10	13	5.0	16	5.4	19	10
1941	6+	9.5	0	1.7	7.7	0.8	5.9	4.8
1940	7+	2.2	3.3	3.3	3.8	0.7	5.3	2.4
1939	8+	5.6	3.3	0	5.6	1.4	3.5	3.7
1938	9+	2.8	6.7	0	3.3	1.2	3.5	2.3
1937	10+	0	0	0	0.2	0	0	0.1

Table 5.
Number of 1947 Brood caught during 1947.
(Figures in brackets refer to the number of hauls).

Month	Shetland	Orkney	Moray Firth	Northern Area	Central Area	West Coast
July	1 (5)	—	—	2 (16)	—	—
August	0 (1)	0 (1)	2 (3)	0 (3)	—	13 (15)
September	—	—	—	22 (5)	27 (18)	—
October	40 (4)	—	—	195 (10)	—	—
November	—	0 (1)	0 (2)	0 (2)	60 (10)	—
December	—	—	—	—	8 (4)	—
Total:	41 (10)	0 (2)	2 (5)	219 (36)	95 (32)	13 (15)

from this region had suffered approximately 60 % depletion in numbers, as against 30 % in the other regions. This may, in part, be explained by their more rapid rate of growth in this area, with the consequent earlier entry into the commercial landings. Also, the larger members may have joined the northward spawning migration during February and March.

Recruitment of Young Brood.

Table 4 shows that the 1946 brood was poorly represented throughout the North Sea compared with the 1945 and 1944 year-classes. Its greatest density was in the coastal waters to the east of the Shetlands, but here it was present in small numbers compared with the 1945 brood in its second year of life. The Orkney grounds, which maintained the densest concentrations of the 1945 age-group in its second and third years of life, and which usually constitute a nurse area for young haddock, had received very scanty recruitment from the 1946 brood. Its numerical strength over the North Sea was in fact the lowest on record for any brood in its second year.

The 1947 age-group first appeared in the trawl catches in July. The numbers captured per month during 1947 are summarised in Table 5.

This brood appeared in greatest numbers in the deep water to the north-east of the Shetlands, concentrations which may have sprung from spawners to the west of the islands. Local shoals were also

located at the entrance to the Firth of Forth in November. Over the greatest part of the North Sea, however, its numbers were small compared with earlier prolific broods in their first year of life. It is not possible to assess its recruitment value from these records alone, however, since all its members may not have taken to the bottom during the sampling period.

Size Composition and Rate of Growth.

The parameters defining the size composition of the catches from the regions visited during 1947 are given in Table 6, together with those for the sample from the whole of the North Sea. The size distribution is also presented in histogram form in Fig. 5.

It is seen from Table 6 that the average size of haddock in the central, Moray Firth and west coast areas was larger than in northern regions. In the latter, approximately half of the fish were under 27 cm, and three-quarters were less than 30 cm, whereas in the shallower waters to the south the corresponding values were 4 cm. higher. The samples, however, were characterised by a narrow size range dominating the population. This is reflected by the high peak of the distribution drawn in Fig. 5. The higher values of the parameters for the Moray Firth and west coast samples can be explained in part by their containing a greater relative proportion of the III+ and IV+ age-groups than the northern area and Shetland ones, but in the central

Table 6.
Size Composition of Haddock Catches in 1947
(All values expressed in centimetres).

	Shetland	Orkney	Moray Firth	Northern Area	Central Area	West Coast	Total
Size Range	6—64	17—54	8—51	8—66	8—68	7—58	6—64
Median	27.3	26.3	31.5	26.0	31.4	30.4	28.5
Upper Quartile	31.6	30.7	34.7	29.8	34.8	37.6	33.5
Lower Quartile	25.1	23.7	28.6	24.2	28.5	27.2	26.5
Inter-Quartile Range	6.5	6.9	6.1	5.6	6.3	10.4	7.0

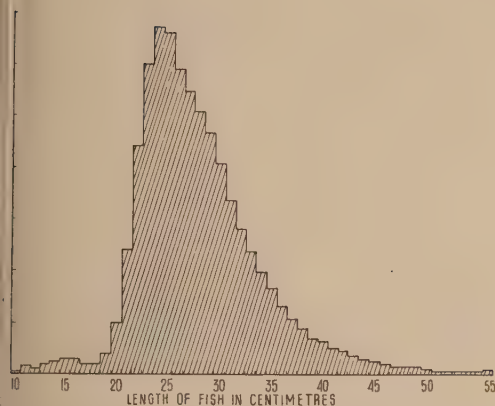


Fig. 6. Size Composition of North Sea Haddock Catches in 1947. (Number at each centimetre length equals average catch p. 10 hours fishing). (Figures smoothed in 3's.)

in the northern areas the proportion of each age-group was approximately the same. Here the difference could only be explained by a greater average size of the youngest broods dominating the population. This difference is illustrated by Table 7 which contains the average sizes of the four youngest broods in each of the areas for three-monthly periods throughout the year.

The average sizes of all the age-groups considered in Table 7 were greater for each quarter

from the central than from the northern area. The mean differences between these areas for the 1945 and 1944 broods, which were present in greatest numbers in each, were 5.0 centimetres and 5.7 centimetres respectively. Differences of these magnitudes are greater than can be attributed to sampling variations. On the other hand, the observed differences between the Shetland and northern area samples may be attributed to errors of random sampling. Thus, the growth of the young broods in the shallow waters was greater than those on the deep water grounds, with the result that the 1945 brood suffered greater commercial exploitation in the former than in the latter during the year.

The Commercial Trawl Fishery.

The total weight of haddock landed in three-monthly periods by British trawlers from the North Sea during 1947, together with the intensity of fishing and the average catch per 100 hours, are summarised in Table 8. These figures are taken from monthly returns compiled by the Ministry of Agriculture and Fisheries.

The results show a marked increase in the total landing and average yield in the last quarter of the year compared with the earlier months. These figures, however, refer to the total haddock landing, and the total fishing effort throughout the North Sea, and include landings from the southern North Sea where haddock is not the species sought after and where it contributes little to the total catch. The landings have been considered therefore from three

Table 7. Mean Size of Haddock in North Sea Samples in 1947.

	1947 Brood		1946 Brood			1945 Brood			1944 Brood		
	July to Sept.	Oct. to Dec.	Apr. to June	July to Sept.	Oct. to Dec.	Apr. to June	July to Sept.	Oct. to Dec.	Apr. to June	July to Sept.	Oct. to Dec.
Mean Size	—	13.8	18.7	21.0	23.8	24.6	25.9	27.9	31.3	31.2	34.6
Size Range	—	9—17	14—20	20—22	20—26	19—31	21—33	21—38	25—43	26—39	30—44
No. of Fish	—	40	32	6	67	1925	1079	1230	217	378	131
Mean Size	—	—	17.0	—	—	24.5	29.3	29.5	32.0	36.0	35.7
Size Range	—	—	17	—	—	20—33	24—37	27—34	29—37	30—41	30—43
No. of Fish	—	—	1	—	—	462	137	11	24	58	28
Mean Size	10.0	—	18.5	22.0	—	24.7	29.7	32.0	38.2	36.5	40.6
Size Range	8—12	—	17—20	22	—	20—31	26—39	25—41	33—41	31—46	34—51
No. of Fish	2	—	13	2	—	98	641	167	5	222	31
Mean Size	12.1	15.0	18.3	21.7	22.6	24.0	25.1	27.3	31.1	32.0	34.2
Size Range	8—16	12—16	15—21	17—27	21—25	19—32	20—37	21—39	25—43	28—45	28—44
No. of Fish	93	197	47	86	23	3201	3241	1104	462	657	146
Mean Size	12.2	17.8	19.6	24.9	26.7	27.0	31.3	33.0	34.3	39.2	41.0
Size Range	10—13	14—21	15—22	20—29	23—30	20—34	22—41	26—42	30—43	30—50	36—49
No. of Fish	27	68	22	24	24	684	1262	1024	103	176	144
Mean Size	9.8	—	—	—	—	26.7	28.6	—	34.1	35.9	—
Size Range	8—12	—	—	—	—	23—35	23—40	—	31—37	30—48	—
No. of Fish	13	—	—	—	—	72	772	—	5	329	—

Table 8.
Total North Sea Haddock Landings
in 1947.

Month	Weight Landed	Hours Fishing	Landing per 100 Hrs.
January to March	128,244	206,055	62.2
April to June	130,536	259,419	50.3
July to September	173,286	284,247	61.0
October to December	398,905	323,045	123.5
Total:	830,971	1072,766	77.5

separate regions; the first two corresponding roughly with the northern and central areas respectively referred to in this report, and the third comprising the grounds to the south of latitude 53°30'N. which were not covered in the 1947 research vessel survey. The catch, intensity of fishing, and average yield per 100 hours from each of these regions are given in Table 9, together with the corresponding 1938 figures for comparison.

It will be observed that in each region the density of the haddock stocks, as measured by the yield per 100 hours, was greater in 1947 than in 1938. The greatest difference in density was in the central and southern regions, where the 1947 figures for the year were approximately four times greater than in 1938. In all regions during 1947 the yield per 100

hours rose sharply during the last quarter of year, reaching its highest value in the north region. This rise in all regions can be attributed at least in part, to the increasing contribution to market landings of the upgrowing 1945 brood.

Summary.

The 1947 survey, whilst omitting some North Sea haddock grounds, included the areas in which the main haddock fishery for British trawlers was concentrated. The composition of the stock outlined above, may be regarded therefore as representative of those upon which their activities were based. The catches were composed mainly of fish younger than four years of age, amongst which the 1945 and 1944 age-groups made up approximately 95 % of the total numbers. The 1945 brood was the most prolific in all regions, although its strength to the south of the 100-metre contour was less than in the deeper waters to the north. In shallower waters the average size of the younger age-groups was significantly greater than in the northern areas, with the result that the upgrowing 1945 brood entered the commercial fishery at an earlier date.

Recruitment was of a low order; the numerical strength of the 1946 brood being the lowest throughout the North Sea since researches began. The 1945 brood which appeared in the trawl catches during the late summer and autumn months, was poorly represented compared with prolific broods in their first year.

Table 9.

		Date:	Jan. to March	Apr. to June	July to Sept.	Oct. to Dec.	Total for Whole Year
N. of Lat. 57°30'N.	Weight Landed (Cwts)	1938	168,532	146,463	112,105	166,877	593,977
		1947	79,809	54,668	17,692	89,209	241,378
	Hours Fishing	1938	152,786	115,403	113,698	144,777	526,664
		1947	42,404	44,071	22,610	37,823	146,908
	Catch per 100 Hours	1938	110.3	126.9	98.6	115.3	112.3
		1947	188.2	124.0	78.3	235.9	164.1
Lat. 55° to 57°30'N.	Weight Landed (Cwts)	1938	15,837	30,701	113,217	80,211	239,966
		1947	24,218	48,166	96,528	220,253	389,165
	Hours Fishing	1938	76,847	117,224	173,143	120,895	488,110
		1947	21,068	52,161	83,328	93,380	250,937
	Catch per 100 Hours	1938	20.6	26.2	65.4	66.4	49.9
		1947	115.0	92.3	117.3	230.9	155.2
S. of Lat. 55°N.	Weight Landed (Cwts)	1938	938	4,339	13,139	9,069	27,485
		1947	1,597	8,648	29,203	42,645	82,093
	Hours Fishing	1938	256,036	150,717	190,256	202,249	799,258
		1947	130,905	144,948	155,586	171,179	602,618
	Catch per 100 Hours	1938	0.4	2.9	6.9	4.5	3.7
		1947	1.2	6.0	18.8	24.9	13.1

the growth of the prolific 1945 brood, both north and south of the 100-metre contour, contributed to a greatly increased commercial yield of haddock during the last quarter of the year.

B. B. Parrish.

Fishes in Scottish Waters - 1947.

Lemon Sole. The size frequencies and age composition of the lemon soles caught by the "Explorer" during 1947 are given in Tables 10 and 11 which include the records of the "Kathleen" operating mainly within coastal waters of the Moray Firth, Aberdeen Bay and the Firth of Forth.

Table 10.

	Explorer S. of 58°30'N.		Explorer N. of 58°30'N.		Kathleen Coastal Waters	
	No.	%	No.	%	No.	%
15	2	1.2	5	4.3	10	9.4
20	5	3.1	15	13.1	32	30.2
25	15	9.2	30	26.1	26	24.5
30	32	19.6	28	24.4	21	19.8
35	48	29.4	26	22.6	15	14.2
40	49	30.1	9	7.8	2	1.9
45	12	7.4	2	1.7	—	—
Total	163	100	115	100	106	100

Table 10 shows that on southern grounds the proportion of lemon soles were of 31—40 cm. length. Compared with the corresponding 1946 figures this reveals a higher percentage of large fish in 1947. This cannot be taken as indicating an increase in the numbers of large fish, however, but rather that sampling was nearer to the pre-war standard on offshore grounds and that the "Explorer" figures for 1947 are closer to the actual proportions than those of 1946. Similarly the figures for northern grounds, while once more valuing the greater numbers of small fish as compared with southern grounds, also show higher proportions of larger fish than do the corresponding figures for 1946. This also may be explained by more representative sampling of Scottish waters in 1947. The "Kathleen" records from coastal waters show high proportions of small fish.

Age analysis of the catches shows that on south-offshore grounds the 1943 brood is the most numerous although the 1939 brood from the point of view of weight and numbers is the most outstanding. Older broods 1936—1938 continue to lay well. On northern grounds the 1941 brood is first place with 20% of the catch while the 1938 and 1939 broods follow in numerical importance. These results are not unlike those of 1946 though it is clear that the 1939 brood has been reduced in numbers. The "Kathleen" records reveal

Table 11.

Brood	Explorer S. of 58°30'N.		Explorer N. of 58°30'N.		Kathleen Coastal	
	No.	%	No.	%	No.	%
1946	—	—	—	—	1	0.9
1945	3	1.9	2	1.7	38	35.8
1944	13	8.4	5	4.3	13	12.3
1943	28	18.1	20	17.4	32	30.2
1942	10	6.5	16	13.9	6	5.7
1941	20	12.9	23	20.0	8	7.6
1940	18	11.6	9	7.8	2	1.9
1939	25	16.1	18	15.7	5	4.7
1938	11	7.1	5	4.3	—	—
1937	12	7.7	8	7.0	1	0.9
1936	13	8.4	7	6.1	—	—
1935	2	1.3	1	0.9	—	—
1934	—	—	1	0.9	—	—
Total	155	100	115	100	106	100

the predominance of the young 1945 and 1943 broods but further investigations will be necessary before it can be stated whether these represent years of successful recruitment.

In view of the scarcity of records from the research vessel it has been necessary to rely more on commercial samples for a fuller appreciation of the composition of the lemon sole stocks. For this purpose thirty samples were collected from Aberdeen fishing vessels throughout the year. The size and age composition of these samples are set out in Tables 12 and 13 according to their place of origin.

Table 12.

Length cm.	S. of Rattray H.		Outer Moray F.		Various: N. of 58°30'N.	
	No.	%	No.	%	No.	%
21—25	81	4.8	56	13.5	11	6.7
26—30	244	14.6	147	35.4	44	26.8
31—35	450	26.9	123	29.7	62	37.8
36—40	660	39.4	66	15.9	31	18.9
41—45	232	13.8	23	5.5	15	9.2
46—50	8	0.5	—	—	1	0.6
Total	1675	100	415	100	164	100

On the main lemon sole grounds lying south of the latitude of Rattray Head, it is shown by Table 12 that, in comparison with 1946, a gradual fall is taking place in the average size of the stocks. Increases in the percentage of fish in all size groups below 36 cm. and decreases in the larger size groups are to be observed. This shows that the stocks of large lemon soles (mainly 1936 brood), which accumulated over the war years, have now been well reduced. The 1936 brood, for example, is calculated to have been reduced by about 44% during the course of the past year alone. This reduction of the large fish, estimated at about 29%, would

undoubtedly be more marked but for the effect of another good brood — that of 1939 — which is now supplying a good proportion of large fish. In the outer Moray Firth and on grounds of less importance north of 58°30'N. a similar rise in the percentage of small fish and fall in the percentage of large fish is noticeable.

Age analysis of the catches from southerly grounds show the 1939 brood to be the most numerous. Next comes the very good 1936 brood; although now much reduced in numbers this brood continues to provide a large part of the weight of lemon soles caught by trawlers since its individuals are now all large fish. The 1937 brood estimated as being of good-medium strength also provides a

Table 13.

Brood	S. of Rattray Head		Outer Moray Firth		Various N. of 58°30'N.	
	No.	%	No.	%	No.	%
1944	43	2.6	25	6.1	—	—
1943	188	11.3	137	33.5	8	4.9
1942	109	6.5	35	8.6	24	14.6
1941	178	10.7	56	13.7	25	15.2
1940	122	7.3	22	5.4	19	11.6
1939	366	22.0	52	12.7	29	17.7
1938	157	9.4	23	5.6	9	5.5
1937	188	11.3	16	3.9	14	8.5
1936	242	14.5	28	6.8	12	7.3
1935	47	2.8	9	2.2	10	6.1
1934	21	1.3	6	1.5	12	7.3
1933	6	0.3	—	—	—	—
1932	—	—	—	—	2	1.2
Total:	1667	100	409	100	164	100

good proportion of the fish caught but the 1941 brood cannot be regarded as better than medium strength although it appears to be more numerous on northern grounds. The 1938 brood, on the other hand, has a southerly distribution but has never appeared outstanding. The 1940 and 1942 broods have contributed comparatively few fish to the stocks. Of the younger broods that of 1943 shows promise of being above average strength and has been appearing in good numbers in the trawler catches during the latter half of the year. Its main distribution so far appears to be off the Aberdeenshire coast, west of 1°W. longitude, and at the northern entrance to the Moray Firth in the region of Noss Head and the Pentland Skerries.

The proportions of the various broods in the outer Moray Firth and on still more northerly grounds resemble, on the whole, those already discussed, but with local differences due to the distribution of the broods.

Megrim and Witch. Age analyses of both these species have been carried out on the catches of the research vessels for 1946 and 1947. Both otoliths

and scales have been utilised — frequently method being used as a check on the other.

Table 14 shows that the stocks of these species are composed of as many as fourteen broods in the case of the megrim and slightly fewer in the case of the witch, with older broods fairly well presented. In this respect they resemble the lemon sole. It is clear too that brood survival may range from good to poor as in the case of other species. The 1942 brood, for example, appears as the standing brood in the megrim samples for 1947.

Table 14.

Brood	Megrim				Witch			
	1946		1947		1946		1947	
	No.	%	No.	%	No.	%	No.	%
1947	—	—	—	—	—	—	—	—
1946	—	—	4	0.9	3	0.9	—	—
1945	8	1.0	27	6.1	10	3.0	—	—
1944	16	2.0	50	11.4	166	50.6	—	—
1943	97	11.9	110	25.1	54	16.5	—	—
1942	249	30.5	111	25.3	22	6.7	—	—
1941	94	11.5	33	7.5	23	7.0	—	—
1940	80	9.8	32	7.3	18	5.5	—	—
1939	124	15.2	34	7.7	13	4.0	—	—
1938	81	9.9	25	5.7	11	3.4	—	—
1937	30	3.7	6	1.4	2	0.6	—	—
1936	21	2.6	3	0.7	3	0.9	—	—
1935	12	1.5	2	0.5	3	0.9	—	—
1934	2	0.2	1	0.2	—	—	—	—
1933	1	0.1	—	—	—	—	—	—
1932	1	0.1	1	0.2	—	—	—	—
Total:	816	100	439	100	328	100	237	100

Concurrently with the age analyses, investigations have also been carried out on the stomach contents of megrim and witch. The two species show a sharp contrast in their food types. While the megrim feeds on fish and Crustacea (chiefly capoda, such as Crangon etc.) the witch consumes itself almost exclusively to Polychaete worms, small quantities of Crustacea such as Amphipoda and Decapoda, e. g. Calocaris.

Turbot. Although this species is less numerous in Scottish waters than those already dealt with it is not frequently taken by the research vessels, interesting to record that more turbot were caught by the "Explorer" in 1947 than in any of the immediate pre-war years. This indication that the species is more numerous in the NW. North Sea is also borne out by the landings of Aberdeen trawlers. Normally, turbot are taken in quantity during the summer months on Aberdeen and Turbot Bank but throughout the latter half of 1947, into December, good catches continued to be landed from banks and also from more northerly grounds such as Stormy Bank, Fair Isle and East Shetland.

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ish Investigations.

Table 15.
Herring caught by Trawl from Danish Cutters.

Date, Locality and Maturity of Sample.							Length Distribution (‰).									
Locality		Date		Position			cm	24	25	26	27	28	29	Total		
Fladen		27/8		58°50'N. 0°05'E.			Mat. II, III, IV	1	5	2	2	2	—	12		
							„ V	—	9	27	30	15	4	85		
							„ VIII	—	—	—	—	1	—	1		
							Total:	1	14	29	32	18	4	98		
III	IV	V	VI	VII	VIII	No. of Fish										
6	4	85	—	—	1	120										
							Age Composition (‰).									
Racial Characters (No. of Indiv. in brackets).							Rings	2	3	4	5	6	7	8	9	10
Locality	II, III, IV and VIII					V	Mat. II, III, IV	2	7	3	0.6	1	—	—	—	—
S.	56.71 (24)					56.59 (96)	„ V	2	12	14	21	16	9	8	1	1
P.	24.25 (24)					24.17 (96)	„ VIII	—	—	—	0.6	—	0.6	—	—	—
	14.08 (24)					14.77 (95)	Total:	4	19	17	22	17	10	8	1	1

Age J. C. Jensen.

Scottish Investigations.

Only a limited programme of sampling of commercial drift-net catches from the Fraserburgh and head areas, and of trawled catches from the open ground could be undertaken during 1947. Analyses of the samples of trawler herring are

only now being prepared for the microscope and the results are not yet available.

There was evidence of a lag in the cycle of the fishery and in the appearance of the normal plankton organisms. Catches of drifters were in the average considerably smaller than in 1946, but there is good reason for believing that this was due more to

Table 16.
Summary of the Data available.

Grounds 5 to 60 miles E. × N. to NE. × E. of Fraserburgh.

		Maturities (‰).								No. of Fish
Sample No.	Date	I	II	III	IV	V	VI	VII	VII-II	
1	July 1	11.8	53.8	27.2	4.1	—	—	—	3.1	195
2	" 16	31.7	40.8	18.3	8.7	0.5	—	—	—	218
3	Aug. 12	—	1.0	—	40.0	41.0	7.0	11.0	—	200
4	" 27	—	—	—	9.3	22.2	49.5	19.0	—	216

		Size Distribution (‰) to nearest cm.								
Sample No.		23	24	25	26	27	28	29	30	31 cm.
1		0.5	7.7	28.2	31.8	21.5	9.2	1.0	—	—
2		0.5	7.8	29.4	28.9	19.7	11.9	1.4	0.5	—
3		—	—	0.5	1.0	10.0	38.5	37.0	10.5	2.5
4		—	0.5	3.2	8.3	17.6	38.9	23.6	7.4	0.5

		Age Composition (‰).									Winter Rings
Sample No.		2	3	4	5	6	7	8	9	10-12	
1		12.8	26.2	25.1	16.4	11.3	3.1	1.0	3.1	1.0	
2		37.6	15.6	24.3	10.1	9.2	3.2	—	—	—	
3		—	3.0	10.0	33.0	5.0	25.5	9.0	8.5	6.0	
4		6.9	5.6	19.0	24.1	10.2	13.4	9.7	7.9	3.2	

Table 16 (continued).

Grounds 30—38 miles E. × S. to 30 to 40 NNE. miles of Peterhead.

Sample No.	Date	Maturities (‰).								No. of Fish
		I	II	III	IV	V	VI	VII	VII-II	
1	July 8	34.5	50.0	14.0	1.0	—	—	—	0.5	200
2	" 23	26.4	25.0	28.6	14.1	5.9	—	—	—	220
3	Aug. 19	1.3	2.7	19.6	28.1	12.5	1.3	34.4	—	224
4	Sep. 3	—	—	0.9	47.6	24.4	0.9	26.3	—	217

Sample No.	Size Distribution (%) to nearest cm.										
	22	23	24	25	26	27	28	29	30	31 cm.	
1	1.5	8.0	20.5	28.0	20.0	16.0	4.5	1.5	—	—	
2	—	6.8	13.6	28.6	27.3	12.7	9.1	1.8	—	—	
3	—	0.9	5.4	13.4	20.5	22.8	17.4	15.6	3.6	0.4	
4	—	0.5	—	1.4	3.2	16.1	40.6	32.7	3.7	1.8	

Sample No.	Age Composition (⁰ / ₀).									Winter Rings
	2	3	4	5	6	7	8	9	10-12	
1	31.5	22.0	21.5	12.5	6.5	2.0	2.5	0.5	1.0	
2	39.5	25.0	15.9	10.9	3.6	3.6	—	1.4	—	
3	5.8	19.2	26.3	21.4	9.4	9.8	4.9	3.1	—	
4	0.5	3.7	12.9	22.1	12.4	16.1	17.1	6.5	8.7	

Fraserburgh and Peterhead Samples Combined.

Period	Maturity	Counts of Vert. S. (‰).								No. of Fish
		Winter Rings	54	55	56	57	58	59	Mean	
July 1—23	I	2	0.6	—	25.8	60.7	12.9	—	56.85	178
"	II	2	—	2.3	61.4	34.1	2.3	—	56.36	44
"	I—II	3	—	1.8	39.1	51.8	7.3	—	56.65	110
"	III—V	3	—	4.5	58.2	34.3	3.0	—	56.36	67
"	III—V	2—12	—	3.6	52.6	39.4	4.4	—	56.45	249
Aug. 12 to Sep. 3	IV—VII	2—12	0.6	5.0	49.5	40.7	3.9	0.3	56.43	777

a prolonged spell of very calm weather than to a reduction in the stock of herring. Very good catches of herring were obtained on the Fladen and adjacent grounds from early August until the third week of November.

It will be seen that an important change in the composition of the catches took place on the Fraserburgh grounds between July 16 and August 12, and on the Peterhead grounds between July 23 and August 19. Comparable changes take place every summer but normally a little earlier than was the case in 1947.

Vertebrae were counted in all samples. A summary is given which brings out the most notable features in the data.

The two-ringers at stage I, which were prominent in the catches during July gave a Vert. S count which indicates a predominance of spring spawners. There is an indication that some spring spawners were present in the three-ringers grouped under

maturities stages I and II. Apart from these exceptions the material has the characteristics typical of autumn spawning herring.

Henry Wood

**Observations Biologiques
sur les Concentrations de Harengs Pleins
du "Fladen" et du "Gut".**

(Matériel prélevé en août—septembre 1947).

C'est en 1946 que l'étude biologique des concentrations de harengs au Fladen et au Gut a été entamée. Vu l'importance qu'attachent les pêcheurs belges à l'exploitation de ces bancs de harengs pleins, leur étude a été reprise en 1947.

De même qu'en 1946, le matériel d'étude a été prélevé au cours des mois d'août et de septembre et exclusivement dans les régions du Fladen et du Gut.

matériel comprend 10 séries d'échantillon-
de 50 harengs chacune, soit au total 1000
gs, ou 500 par mois.

En 1946 le matériel prélevé au Fladen et au
vait été traité séparément. Ceci pour vérifier
composition des bancs de harengs était la
dans les deux régions. Etant donné que l'ex-
périence fut concluante, nous nous sommes abste-
né de scinder encore les résultats par région, afin

de ne pas charger inutilement les tableaux stati-
stiques.

Par ailleurs, comme il est établi que même dans
une région donnée, la composition des bancs de
poissons est sujette à des variations remarquables,
nous avons jugé plus opportun de scinder les ob-
servations en périodes mensuelles, méthode qui
permettra de déceler et de suivre mois par mois
et dans l'espace tout changement qu'elle pourrait
subir.

Taille (°/o). (Les mensurations ont été faites au millimètre).

Tailles en cm.	21	22	23	24	25	26	27	28	29	30
Août	—	1.4	3.4	12.2	20.2	26.0	23.2	10.2	3.0	0.4
Septembre	0.4	0.6	3.8	5.8	13.4	23.0	30.8	17.0	4.8	0.4
Générale	0.2	1.0	3.6	9.0	16.8	24.5	27.0	13.6	3.9	0.4

Mois	Stades de Maturité. (Pourcentage)							Graisse Mésenterique.			
	I	II	III	IV	V	VI	VII	0	1	+	M
Août	5.6	12.0	12.8	30.2	38.4	0.2	0.8	4.6	31.0	40.8	23.6
Septembre	3.8	7.8	2.2	9.2	50.2	13.0	14.2	22.8	50.8	14.2	12.2
Les 2 mois	4.7	9.9	7.5	19.7	44.3	6.6	7.3	13.7	40.9	27.5	17.9

Age.

	2	3	4	5	6	7	8	9	+
	3	4	5	6	7	8	9	10	+
Anneaux d'hiver									
Age (ans)									
Classe annuelle	1944	1943	1942	1941	1940	1939	1938	1937	Anté- rieure
Pour 100	5.31	8.75	17.19	13.75	18.75	11.88	10.94	4.37	9.06

Les échantillons ayant été conservés dans la glace, beaucoup de harengs étaient dépourvus
d'écaillés lisibles. Il s'en suit que le dénombrement des anneaux d'hiver n'a été possible que pour
320 harengs (172 en août et 148 en septembre), alors que le nombre de harengs soumis à l'analyse
s'éleva à 1000 individus.

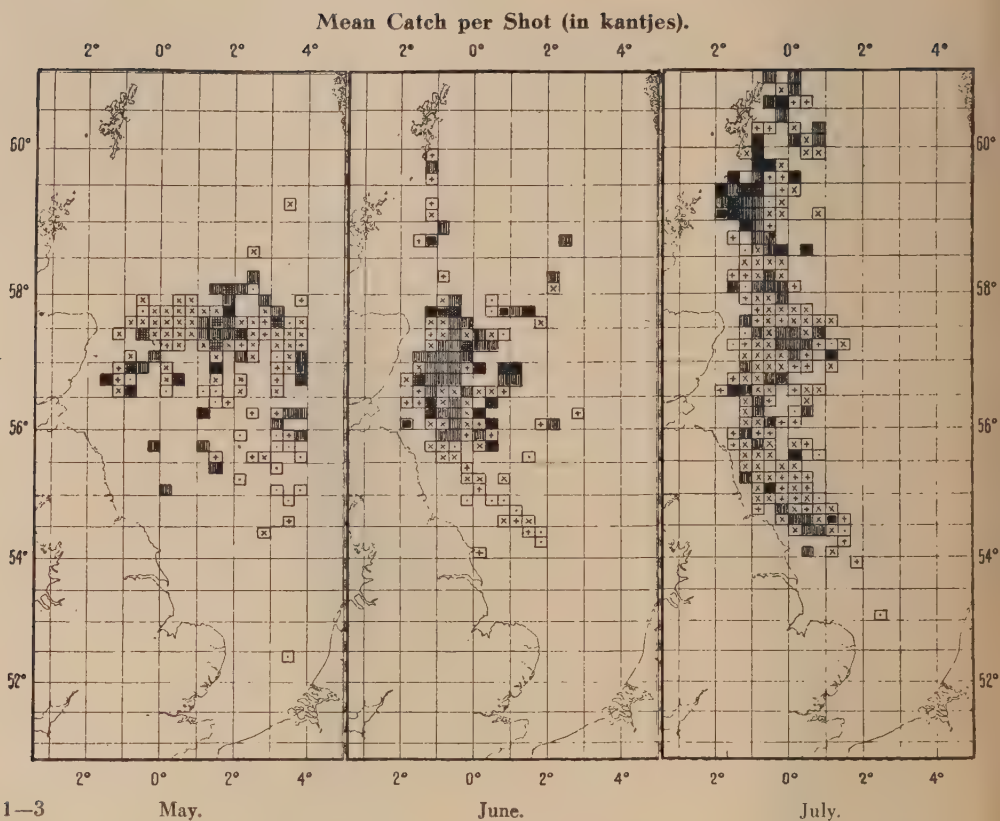
	Nombre de Vertèbres. (Pourcentage)							Nombre de Vertèbres Cervicales.						
	54	55	56	57	58	59	Moyenne	22	23	24	25	26	27	Moyenne
Août	0.4	5.0	43.8	44.2	6.0	0.6	56.522	1.8	26.2	50.8	18.2	2.8	0.2	23.95
Sept.	0.2	4.0	44.2	45.6	6.0	—	56.532	1.2	24.6	53.0	17.4	3.3	—	23.98
Les 2 mois	0.3	4.5	44.0	44.9	6.0	0.3	56.527	1.5	25.4	51.9	17.8	3.3	0.1	23.96

Ecaillés en Carène (°/o).

Nombre d'écaillés	11	12	13	14	15	16	17	18	Moyenne
Août	0.2	1.2	9.8	42.4	37.4	7.0	1.6	0.4	14.45
Septembre	—	0.2	6.8	36.4	44.8	10.6	1.2	—	14.62
Les 2 mois	0.1	0.7	8.3	39.4	41.1	8.8	1.4	0.2	14.54

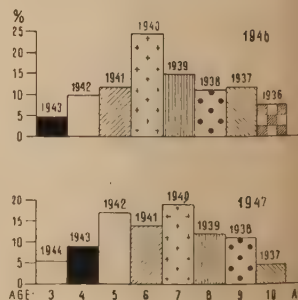
Contenu Stomacal (°/o).

Quantité de nourriture	Plein	1/2 plein	1/4 plein	vide
Août	0.4	2.6	20.4	76.6
Septembre	1.8	3.6	13.8	80.8
Les 2 mois	1.1	3.1	17.1	78.7

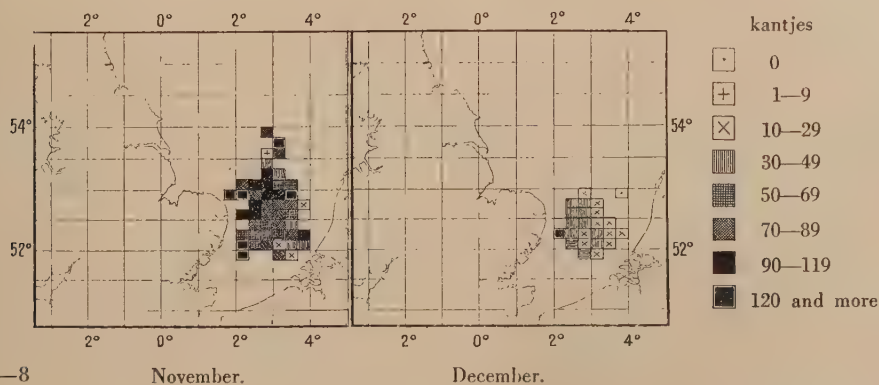
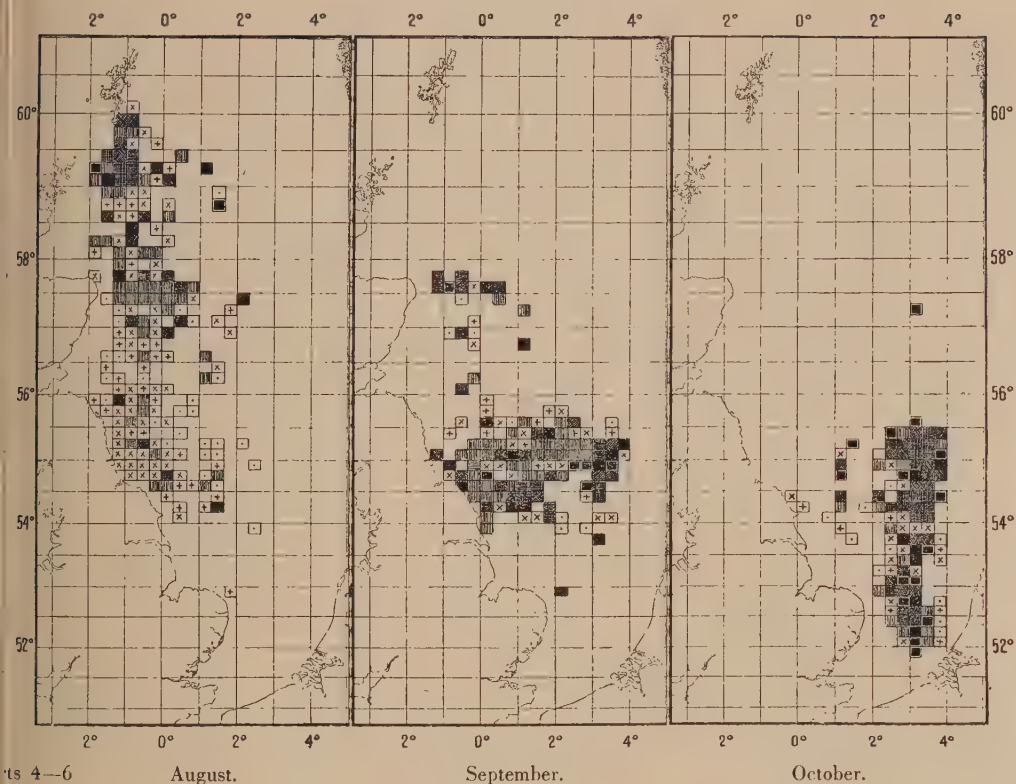


Récapitulation des Valeurs observées.

Observations	Août	Septembre	pour les 2 mois	
Taille en centimètres	21—30	21—30	21—30	
Mode de la taille	26	27	27	
Longueur moyenne	26.34	27.23	26.58	
Poids moyen du hareng en g.	153	156	154	
Répartition pour 100 des sexes	{ mâles 57 femelles 43	54 46	55 45	
Stade de maturité le plus fréquent	V	V	V	
Quantité de graisse la plus fréquente	+	1	1	
Tailles moyennes observées pour les harengs nés en	{ 1944 1943 1942 1941 1940	24.04	24.25	24.12
		24.81	24.57	24.76
		25.94	26.41	26.05
		26.61	26.49	26.57
		26.99	27.18	27.12
Vertèbres: mode	57	57	57	
moyenne	56.522	56.532	56.527	
Vertèbres cervicales: mode	24	24	24	
moyenne	23.95	23.98	23.96	
Ecailles en carène: mode	14	15	15	
moyenne	14.45	14.62	14.54	
Contenu stomacal: (‰ avec contenu)	23.4	19.2	21.3	



Mean Catch per Shot (in kantjes).



the Dutch Herring Fisheries in 1947.

In order to give an impression of the density and the location of the herring shoals on the grounds fished by Dutch fishermen in 1947 a summary is given of the catch statistics by means of charts.

The charts No. 1—16 show the results of the drift-net fisheries. We got the data from the ship's journals of about 80 vessels, that means 34% of the whole lugger fleet fishing with drift-nets. Each vessel was fishing with about 100 nets which may have been set either for surface or for deeper water fishing.

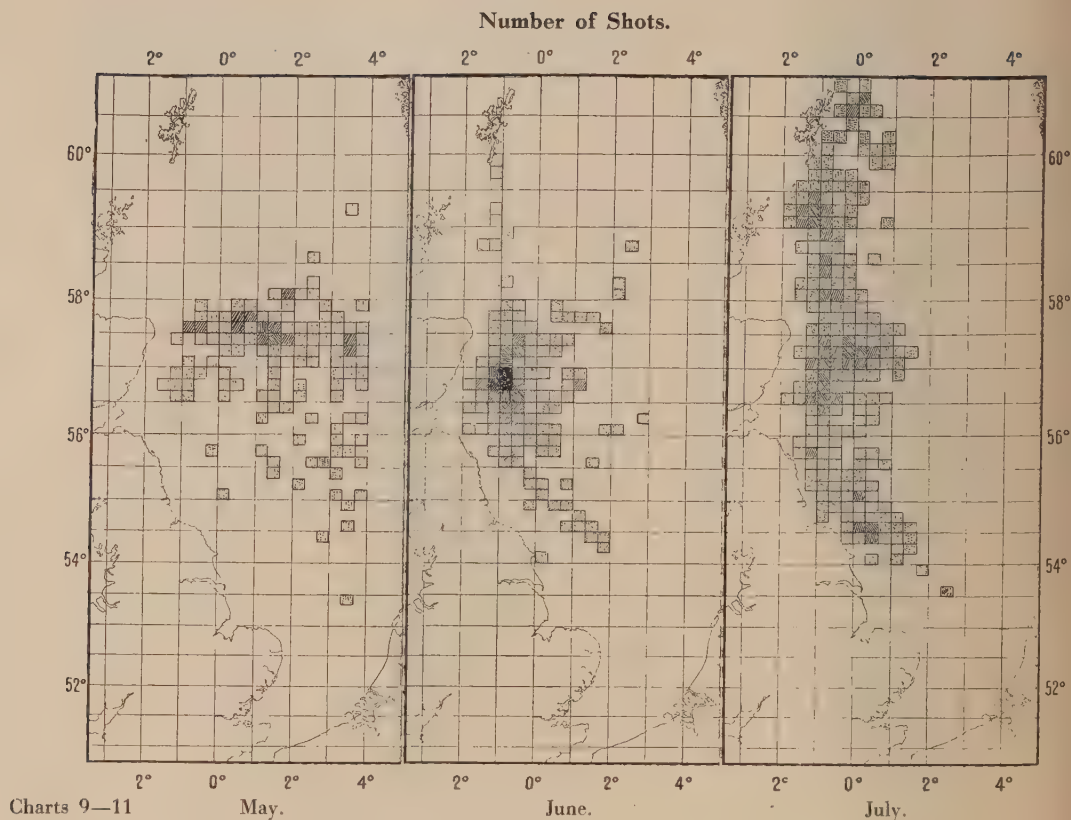


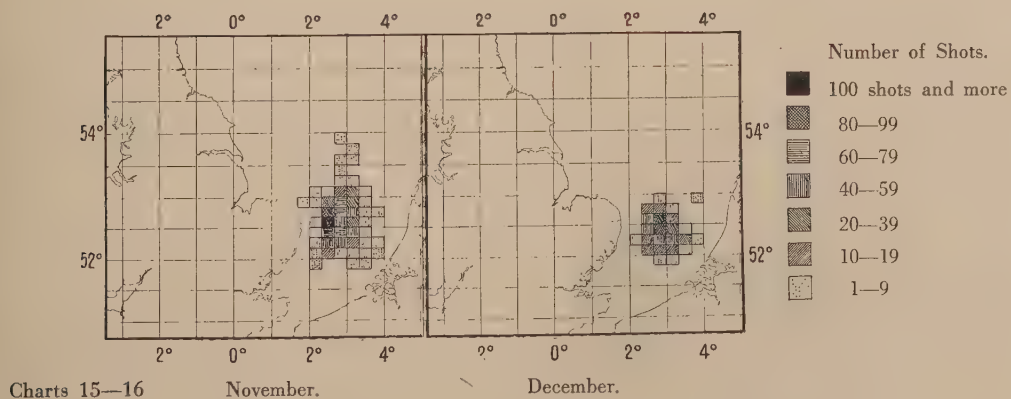
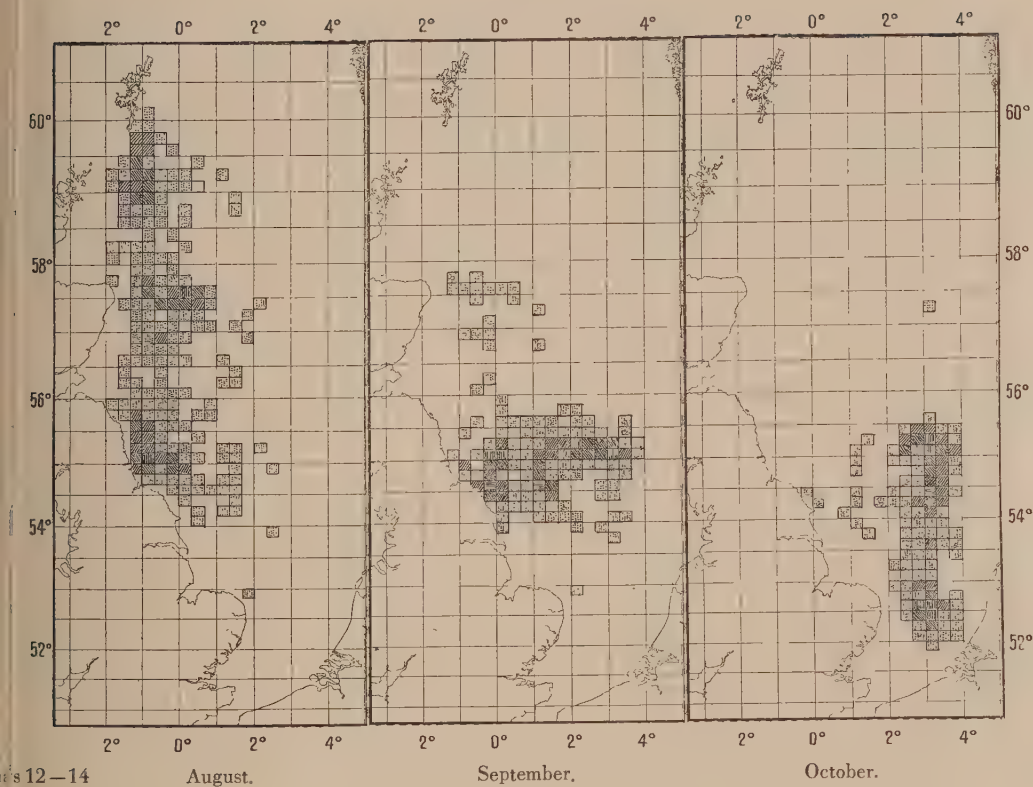
Table 17. Quantities of Herring landed in Dutch Ports in 1947 by the Luggers Fishing with Drift-Nets.

		Salted Herring (in Kantjes)		Ungutted	Fresh Herring (in Kg.)
	Matjes	Gutted Full	Spent		
Jan.	—	29	32	3,478	—
Feb.	—	—	—	—	—
March	—	—	—	—	—
April	—	—	—	—	—
May	29,487	—	—	—	—
June	82,835	—	—	2,373	—
July	68,074	1,417	—	3,600	1,080
Aug.	47,092	25,863	5,014	14,921	15,910
Sep.	16,042	106,123	11,713	21,762	178,985
Oct.	237	79,879	16,645	109,244	1,768,682
Nov.	—	8,522	306	202,087	4,787,309
Dec.	—	2,788	1,730	89,962	2,436,670
Total	243,767	224,611	35,440	452,068	9,188,636

Table 18. Quantities (in tons) of trawled Herring landed in Dutch Ports in 1947.

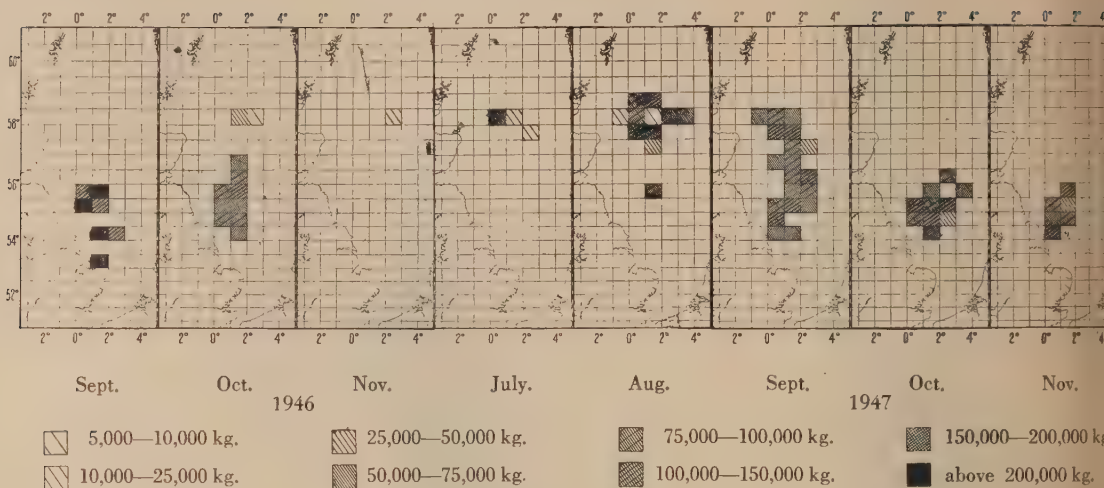
	Trawlers	All Kind of Vessels
Jan.	83.9	592.1
Feb.	155.7	1,729.1
March	2.0	17.1
April	11.1	11.1
May	88.2	115.1
June	1.0	1.1
July	325.9	336.1
Aug.	4,897.7	5,236.1
Sep.	6,844.1	8,308.1
Oct.	6,777.2	7,928.1
Nov.	3,194.3	3,303.1
Dec.	117.4	119.1
Total	22,498.6	27,699.1

Number of Shots



Charts 17—24

Mean catch (in kg.) per 100 hours fishing.



In the charts No. 1—8 the mean number of kantjes herring caught per shot at the different places in each month is indicated. One kantje is equal to 94 kg.

The charts No. 9—16 refer to the number of times the nets were shot in the different rectangles. They show the variety in intensity of fishing on the different grounds and they enable us to verify the reliability of the figures for the size of the catches. When the number of shots is small, these figures may be much influenced by chance.

We don't possess data about the qualities of the herring caught at the different grounds.

Table 17 gives the total quantity of drift-net herring landed. Here the qualities are distinguished except for the ungutted and the fresh herring. The quantities of salted herring are given in kantjes, of fresh herring in kg. The total amount landed, calculated in kg. is 99,041,920 kg. For the charts the catches of fresh herring are calculated into kantjes.

Since September 1946 the trawlers have given details about the place, where they have been fishing. The quantities of herring caught per unit of fishing time (100 hours fishing) are shown in the monthly charts No. 17—24. We have no statements about the kind of trawl-net used (whether herring-trawl or the common otter-trawl), but we may safely assume that in the indicated areas nearly all trawling has been done with the herring-trawl. In some other areas small quantities of herring have been caught, mostly less than 5 tons per 100 hours fishing. The catch figures for other fish species indicate that here most of the vessels will have used the common otter-trawl. Therefore the herring figures from these rectangles will not be comparable with the other ones. Accordingly they have been omitted from the charts.

No special herring-trawl fishery occurred those months for which no chart is given (other than the trawling in January until March for spent herring along the Belgian and Dutch coasts region which we have no data).

Table 18 gives the total quantity of herring landed by the trawlers and by the whole fleet fishing with trawl-nets. The rather big landings in the first months of the year consist of the above-mentioned spent herring, mostly caught by the lugger and the small motor vessels.

J. De Veen and L. K. Boerema

Mackerel.

Mackerel larvae and young stages were abundantly abundant in the northern North Sea area in July and August 1947 and two larvae at 7 and 8 cm length were also taken at Faroe in June.

The distribution of the planktonic larvae taken in July and August is included in the chart, size ranges of these larvae were:—

July						
Sizes in mm.	4	5	6	7	8	9
No.	4	9	19	26	17	15
July						
Sizes in mm.	11	12	13	14	15	
No.	2	6	—	—	1	—
August						
Sizes in mm.	43	46	47	48	49	53
No.	1	1	1	2	1	1
August						
Sizes in mm.	55	56	59	62	67	
No.	2	1	2	1	1	—



Fig. 7. The occurrence of young mackerel in 1947.

Station stations, with (X), and without (—), larval mackerel in July; and with (A), and without (·), larval mackerel in August. Trawling positions in September (S), October to 6th November (O), are ringed where whitefish were found feeding on young mackerel, and double-ringed when mackerel in their first year were taken in the trawl.

The August specimens were all taken in the surface net at a single station at $58^{\circ}46'N$, $0^{\circ}27'W$. and were feeding mostly on *Temora* with some *Anomalo-*
ocera and *Zoeas*.

By September the young fish, aged 0+, had ceased to be caught by the plankton nets but were widely distributed over a large area of the central North Sea, as revealed by the stomach contents of various white fish, chiefly *Gadus merlangus* — see chart. At two stations — $58^{\circ}10'N$, $2^{\circ}34'E$. and $57^{\circ}47'N$, $1^{\circ}11'E$. — a total of 209 specimens were taken in the small mesh covering of the "Explorer" trawl. They had the size range:—

cm.	13	14	15	16	17	
No.	18	96	66	27	2	= 209

The mackerel had further increased in size when samples were next taken during the period 17th October to 6th November and specimens taken in the northern North Sea had the size range:—

cm.	15	16	17	18	19	20	21
No.	1	2	3	8	17	3	6 = 40

In comparison, mackerel — ages 1+ and older — taken in the trawl during the periods had the size range:—

Length in cm.	24	25	26	27	28	29	30	31	32
No. in Sept.	—	—	—	1	2	9	22	28	15
No. in Oct./Nov.	1	1	1	3	3	3	3	6	8

Length in cm.	33	34	35	36	37	38
No. in Sept.	25	55	60	63	26	4 = 310
No. in Oct./Nov.	16	12	7	8	11	6 = 89

J. H. Fraser.

Preliminary Note on the Immigration of Certain Marine Species in Scottish Waters. 1913 to 1947.

Introduction.

Within recent years major changes have taken place in the waters off Plymouth, and are now taking place in the Arctic. Such changes have a profound effect on the fisheries, and it is of importance to Scottish investigators to know if any corresponding changes are taking place in home waters. An analysis of the records of occurrence of marine species, rare in the area, is a suggested method for assessing such changes. Lying as it does on the north-western coast of Europe, the Scottish coast is much affected by variations in the flow of Atlantic water, which may bring with it, in varying degrees, a medley of marine animals whose home is with the Scottish area.

This preliminary note which is restricted to the period 1913 to 1946 is based on an analysis of the

records of stranded whales, turtles, fishes, cephalopods, and a few coelenterates. For the period under consideration the whale records seem the most comprehensive and they have been taken as the basis, the records for the other groups being given against this background. To understand what is happening in the Scottish area, records from the Channel in southern Norway should be included, as well as those from the North Sea. More especially in the northern part of the area, it is probably a case of chance whether the stranding takes place on the Scottish or Norwegian side. One consideration has been kept in mind, namely, that with the possible exception of stranded whales, many more rarities may occur than are recorded, and therefore only a general outline of what the immigrations seem to show is attempted.

Table 19.
Table showing the peak years for stranded whales, Atlantic fishes, and a few other species,
mainly for Scotland.

Year	Whales— Britain	Whales— Scotland	Turtles— England	Turtles— Scotland	Fishes-Atlantic 1 Scotland	Fishes-Atlantic 2 Scotland	Cephalopods Scotland	Other Species { Physalia (England) 3 deep-sea fishes and Sword-fish—Scotland
1913	Peak Year	Peak Year	—	—	Records insuffi- cient	Records insuffi- cient	—	—
1914	—	—	—	—	—	—	—	—
1916	—	Peak Year	—	—	Records insuffi- cient	Records insuffi- cient	—	—
1918	Major peak year	Peak Year	—	—	—	—	1st Record Stenoteuthis caroli	—
1921	Peak Year	—	—	—	—	—	Invasion of Sepia officinalis do.	—
1922	—	—	—	—	—	—	—	—
1923	—	—	—	—	—	—	—	—
1927	Major peak year	Major peak year	—	—	Peak Year	Peak Year	Invasion of Sepia officinalis	—
1932	—	do.	—	—	—	—	—	Physalia — England
1933	—	—	—	—	Peak Year	Peak Year	Invasion of Sepia officinalis	Physalia — England
1934	—	—	—	—	—	—	Invasion of 1st record Sepia elegans	Physalia — England
1935	Major peak year	Major peak year	—	—	—	Suggestion of peak year	Invasion of Ommatostrephes sagittatus	—
1938	do.	—	Numerous records for southern England	—	Peak Year	do.	—	—
1941	Peak Year	Peak Year	—	—	Records insuff.	Records insuff.	—	—
1943	—	Peak Year	—	—	do.	do.	—	—
1945	—	—	—	—	1 in Dec.	—	—	—
1946	—	Peak Year	{ Numbers in S.W. England & Wales Dec. to Jan.	1 in Jan. — Hebrides	Records insuff.	Records insuff.	—	Physalia — England

hales.

taking the strandings on the coasts of Britain whole, it appears that there have been four major waves, in 1918, 1927, 1935 and 1938, with a probable fifth in 1913. As the official collection of records of whales stranded in Britain was only begun in that year, it is possible that the results are incomplete. Other considerations would suggest that 1913 or 1918 had been a "peak" year.

For the major "peak" years the Scottish figures, in the main, followed the general curve, but there are several exceptions. A comparison of the sets of curves is interesting and seems to indicate an invasion of Atlantic waters, in certain years, taken place mainly in the Scottish area.

The "peak" years for the strandings of whales on the British and Scottish coasts respectively (for years underlined) are as follows:—

Britain	? 1913		<u>1918</u>	
Scotland	? 1913	1916	<u>1918</u>	1920
Britain	1921	<u>1927</u>		<u>1935</u>
Scotland		<u>1927</u>	<u>1932</u>	<u>1935</u>
Britain	<u>1938</u>	1941		
Scotland		1941	<u>1943</u>	1946

The general trend of events is illustrated in the accompanying graph (Fig. 8).

The "running down" of the curve for the British since 1940 and the rise in the Scottish figures noticeable.

The incidence of the various species, over the period, shows that there have been changes in the area; with some relation to the "peak" years.

In the whalebone whales, the larger species such as the Finner, Sei and Blue whales ceased to be stranded after 1925, i.e. just before the "peak" period of 1926—28, until 1942—43 when the Finner once more appears, again in a "peak" period. Only whalebone whale stranded in numbers is the Lesser Rorqual, and this shows a marked tendency to have its main strandings, so far as the British area is concerned, round the "peak" years. The toothed whales also show changes in the incidence of the species. Perhaps the most remarkable of all was the appearance in the "peak" years 1927 and 1935 of the False Killer whale, till now presumed to be extinct. The white-beaked Dolphin has come in three main waves, namely: 1920—1932—35 and 1941—44. The increase in the killer whale, already noted by Dr. F. C. Fraser, is marked. The occurrence of the Sperm whale in 1938 and 1946, in conjunction with the Finner strandings in 1942 and 1943, reflects the earlier wave of strandings.

The strong Atlantic influence in the Scottish area in the period 1932—35 is shown in a marked upsurge of strandings of Risso's Dolphin (1933—35), and Cuvier's Whale (1932—35).

3. Turtles.

The Loggerhead was recorded in 1923, when a large specimen was found in the autumn in Skye; and, again, in the winter of 1945—46, when single specimens were found in North Uist and in Unst, Shetland. These correspond with "peak" years for stranded whales. These turtle strandings, however, are small compared with the English and Welsh records, which, even more than the Scottish, link up with the "peak" years for whales. In England and Wales in the winter of 1938—39, there were numerous records of both Loggerheads and Kemp's Loggerhead turtles. Again in 1945—46 there were numerous turtles stranded in SW. England and Wales. The stronger Atlantic flow in that winter is indicated by the fact that this time some turtles were stranded on the north-west Scottish coast.



Fig. 8. Graph showing the number of whale strandings on the British and Scottish coasts. Only identified species have been considered. The occurrence in a locality of one or more individuals of a species on one day, or successive days, has been counted as one "stranding".

From 1913—1937 the records have been taken from the British Museums reports. From 1938—1947 I am indebted to Dr. F. C. Fraser, British Museum, for the figures, and for his permission to use them.

4. Fishes.

A preliminary analysis of the published records of rare Scottish fishes since 1870 would indicate that there have also been periods when they have come with greater frequency than at others. The list of rarer fishes is rather long, and somewhat provisional, but shows a fairly close resemblance to the "peak" years for whales. During the period under consideration, however, the war and certain other factors have left big gaps in the more recent records; but it is hoped that some of them may be narrowed, if not closed, later. The fishes fall into five categories: (1) Atlantic species whose home is in the subtropical waters, (2) Atlantic species which normally migrate to the Cornish and South English coasts, (3) species whose home is in northern waters, (4) species which are probably deep-water forms, and (5) species of the continental shelf.

(1) The list is a fairly long one and, in general, there is no great change in the incidence of the various species, at least of the commoner ones, over the period. The number of species occurring in the

various years does, however, fit in fairly well with the "peak" years of the whales, such as in 1927 and 1938, but differs by one year in the intervening peak, being 1933 as against 1932. The 1935 peak in the whale record has no counterpart in these fishes.

(2) Here again the list is a fairly long one and the common species do not show any marked change during the period.

The numbers taken in each year again show a fairly close agreement with the whales in the "peak" years of 1927, 1932, 1935, 1938.

(3) Fishes of this group appear but rarely and in very small numbers. They require no discussion.

(4) Fishes of this group again are not very numerous but are interesting in that they appear in groups around the peak periods 1913, 1927, 1932 and 1947, the exception being 1938.

(5) The species here are few but tend to come before peak periods.

5. Cephalopods.

The species which can be considered as migrants are few, but their distribution shows points of interest, as does that of some of the resident species.

Taking the latter first, it would seem that *Rossia glaucoptis*, a northern form, has become scarce since 1913. Before that date it was recorded on a number of occasions by E. S. Russell, but since then there are only three records for the Scottish area (1922, 1924, 1927). *Eledone cirrosa* was unusually common in 1933. *Sepietta neglecta*, a southern form, seems to have become established in the area sometime in the early twenties.

Sepia officinalis was reported in numbers in 1922-23, 1932 and 1934; and *Sepia elegans* was recorded for the first, and as yet only time, in 1935.

Stenoteuthis caroli, till then a rare species, appeared from 1921 to 1941 on a number of occasions on both the Scottish and English coasts.

On the whole, while showing considerable faunistic changes during the period, the cephalopod records have little in common with the records of the other groups so far discussed, possibly because they are, in the main, bottom forms, while the other groups are almost entirely pelagic.

6. Summary.

A review of the available records is given in Table 19.

The whales stranded on the British coasts show a wide variation in numbers from year to year, the frequency curve of the numbers stranded shows four well-marked peaks: 1918, 1927, 1935, 1947, and one or two minor ones, which may have some significance. Since 1938 there has been a continuing marked falling off in the numbers stranded. The numbers stranded on the Scottish coast, very generally, except in 1932, follow the curve for the British Isles, till 1940 when, in contrast to the falling in the British figures, the numbers in several years have shown a marked increase.

The incidence of species shows some points of interest, such as the practical absence of the large whalebone whales from 1926 to 1941: the tendency of the Lesser Rorqual to be stranded around "peak" years: the stranding of the False Killer in 1928, 1935 and the increase in the strandings of the Killer whale.

Turtles have appeared in two "peak" periods, mainly on the south-western English coast and in Scotland.

Fishes (Atlantic 1). Fishes from sub-tropical areas have tended to be most frequent in the "peak" years (1935 excepted), so far as the records go.

Fishes (Atlantic 2). Fishes from southern areas have been commonest in all the whale "peak" periods so far as the records go.

The cephalopods have shown some little relation with the "peak" years for whales and fishes, but in the main, they are quite different. Fishes such as *Physalia*, *Velella* and *Ianthina* have appeared in some of the "peak" periods.

While, in general, therefore, there are "peak" years spaced at irregular intervals, in which these various immigrants seem to be specially abundant, there are differences between "peak" year and another. The "peak" years for whales may be different for Scotland and Britain, and the species appearing in the various "peak" years are not all the same. These differences probably indicate a difference in the source or direction, of the flow of Atlantic water. Further analysis may give some indication of source or direction. For this to be properly carried out the records from adjacent areas must also be taken into consideration. Such records should be linked with the hydrographic and plankton records.

A. C. Stephen,
Royal Scottish Museum
Edinburgh.

Southern North Sea.

INTRODUCTION.

ALTHOUGH investigations had not yet been resumed on the pre-war scale there was a substantial increase in activity in the southern North Sea areas during 1947, and the Committee is indebted to the following contributors to this report:

M. Ch. Gilis	Ostend
Dr. Å. Vedel Tåning	Copenhagen
Dr. Aage J. C. Jensen	Copenhagen
Mr. Helge Thomsen	Copenhagen
Dr. W. C. Hodgson	Lowestoft
Mr. S. Holt	Lowestoft
Mr. A. Simpson	Lowestoft
Mr. R. S. Wimpenny	Lowestoft
M. Ancellin	Boulogne
M. M. K. Cox-Heikens	The Hague
M. L. K. Boerema	The Hague

The Environment.

Hydrography. The year 1947 was notable for the low temperature found in the southern North Sea in the winter and early spring and for the high surface temperature found late in the year. An indication of these features appears in the values of the "Vyl" Lightvessel given in Mr. Thomsen's contribution.

Plankton. The year was also distinguished from corresponding periods of 1946 by the heavier and earlier standing crop of plankton caught by the trawls in the Flamborough-Dogger area. The question as to whether the increased average weight of the East Anglian autumn herring compared with that caught in 1946 is related to the percentage of plankton in the plankton, and to the crop weight is to the subject of further enquiry.

The Fish Species.

Fish Eggs and young Fish. The plaice-egg survey in the Southern Bight and eastern Channel, undertaken by Mr. A. C. Simpson, revealed that, not only was the time taken for eggs to hatch extended, but the spawning period was prolonged almost certainly as a result of the cold conditions. Of seven

other species of food fishes whose eggs and young stages were identified during this survey, the majority had their centres of abundance towards the Dutch coast.

The Demersal Catch. General observations made on the Dutch demersal catch showed that while the total landings of steam trawlers was slightly lower in 1947 than in 1946 the catch per 100 hours fishing was rather higher, chiefly on account of increased catches of small cod and haddock. The general tendency however was for a continued decline which was probably greater than it appeared owing to the increase in the proportion of large trawlers in the Dutch fishing fleet. For all species there was an increase in the relative importance of the smaller size-groups.

Cod. The Dutch investigations have pointed out that the origin of large quantities of small cod caught in February—April 1947 by steam trawlers in deep water could be explained by these fish having been driven from the shallower coastal water of the Dutch coast by the severe cold spell of that period. They conclude that the general density trend for this species is downwards.

Haddock. According to the work of Messrs. Boerema and Cox-Heikens the decline of the haddock stocks fished by Dutch steam trawlers in the winter north of the Great Fisher Bank, and in the summer mainly south-east of the Dogger Bank, has been offset substantially by the recruitment of a very good brood-year entering the fishery in 1946 and 1947. Although the catch per hour of this species was higher in 1947 than in 1946, the new year-class was being fished away in 1947 faster than new recruitment could take place.

Plaice. The post-war depletion of the stock of plaice is shown to have continued from 1946 to 1947. This is evident from English, Danish and Dutch investigations. My own figures for the English steam trawler fishery in the southern North Sea show that the catch per 100 hours fishing in 1947 was about 75 % of what it was in 1946, and for the central North Sea outside the Dogger Bank, Dr. Jensen's values for the catch per landing of Danish seiners show a similar drop.

The Danish marking experiments with seine-caught plaice in the Dogger and central North Sea areas show that 23 % of the marked fish were returned in the third month after marking in 1946, whereas in 1947 this proportion was reached in the second month and in pre-war years in the first month. In Dr. Tåning's opinion the pre-war rate of capture will be reached in 1949—1950.

As a result of examining the ratios of the catches of successive age-groups of the same brood Mr. Holt shows the total mortality from 1946 to 1947 to be significantly higher than in pre-war years. He considers the stock to be overfished and that it will reach the pre-war density in a short time. The Dutch investigations find a heavy but diminishing decline from 1946 to 1947 which includes all market categories.

English observations from the North Sea show that the size of plaice landed had decreased compared with 1946 owing to an increased proportion of smaller fish. Danish measurements from some but not all the North Sea areas in which they worked showed the same thing and in most areas it was found that plaice had returned to near their pre-war size.

It appears that the war respite may have allowed the survival of a larger number of mature spawners than usual and that these fish were responsible for the strong year-classes born in 1943, 1944 and particularly in 1945. These would be responsible for the larger proportion of small fish referred to above.

Weight and length for age in respect of North Sea plaice both indicated a reduction in the case of young fish, possibly as a result of the overcrowding of abundant recruit groups, while the older fish were longer and heavier for their age than in the previous year, possibly as a result of the thinning out due to increased fishing.

Sole. The observations in my contribution about this species show that the total landings of English trawlers have now returned to the order of values obtained in the ten years before the war, although the catch per unit of fishing time is still considerably higher. There was, however, a substantial drop in the catch per 100 hours fishing from 1946 to 1947 and there is little doubt that the stock is returning fairly rapidly to its pre-war position. The decline shown by the Dutch fishery for this species is proceeding at a greater rate than that for the plaice.

On the whole the fish caught in the English fishery in 1947 were larger than those of 1946. In addition to the various suggested explanations of this, it has to be remembered that the measurements came from the whole area of the fishery that as the latter was extending in 1947 as minefields were swept, it is possible that some landed and hitherto protected fish were affecting the distribution in 1947.

Herring. The age-composition of the southern North Sea herring in the winter of 1946—1947 characterised by the strength of the 1942 year-class. Evidence of this was given in Dr. Hodgson's contribution last year and it appears in M. Ancellin's report in this volume. M. Ancellin's next most important class is that of 1938. The count of the Belgian spent herring fishery for the same season gives the 1938 class as the most important followed closely by 1936 and finally that of 1942. It is clear that this fishery, further to the east than that sampled by M. Ancellin, consisted of an older population. Two features of the spent herring fishery deserve special notice. Firstly, M. Ancellin points out that the fishery was substantially further north than usual. Secondly, M. Gilis has commenced some most interesting observations on the feeding of the spent and covering herrings. He found the percentages of herring food in December, January and February to be 0.4, 2.6, and 32.9 % respectively, and among the stomachs examined three were full of herring eggs and two of fish larvae. This last observation is of great relevance in connection with the possible effect of herring feeding in such a way on the eggs and larvae of plaice whose principal spawning ground is in the same neighbourhood at this time. It is to be hoped that M. Gilis will be able to continue these observations and if possible give more precise identifications of the eggs and larvae contained in herring stomachs.

In the East Anglian fishery of 1947 Dr. H. O. S. found that the high percentage of young fish promises a good four-year old group as well as good five and six-year groups for 1948. His most interesting finding, however, was that age for age the 1947 fish were very much heavier than those of 1946.

R. S. Wimpenn

ENVIRONMENT.

Hydrography.

Monthly Mean of Salinity and Temperature at Surface and Bottom
at the Lightvessel "Vyl" for a longer Series of Years, and Anomalies
from this Mean in 1946—47.

(From the Danish Meteorological Institute, Nautical Dept.).

Month:	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX
Salinity at Surface.													
Mean	32.4	32.4	32.9		32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6
46	0.4	0.1	0.9	1947	1.2	—	—	1.5	—0.2	—0.6	—0.2	0.5	0.4
Salinity at Bottom.													
Mean	32.6	32.7	33.0		33.0	32.8	32.7	32.8	32.6	33.1	32.9	32.7	32.8
46	0.5	0.1	1.1	1947	1.2	—	—	1.3	0.8	—0.7	—0.1	1.0	0.5
Temperature at Surface.													
Mean	12.2	8.5	5.4		3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0
46	0.3	0.3	0.8	1947	—2.0	—	—	—3.8	—0.3	1.8	1.6	2.0	2.6
Temperature at Bottom.													
Mean	12.7	9.0	6.2		3.9	2.6	3.0	4.7	7.9	11.1	14.1	16.0	15.2
46	0.3	0.2	0.4	1947	—1.9	—	—	—3.9	—3.7	—3.0	—0.7	—1.6	1.5

Helge Thomsen.

Plankton.

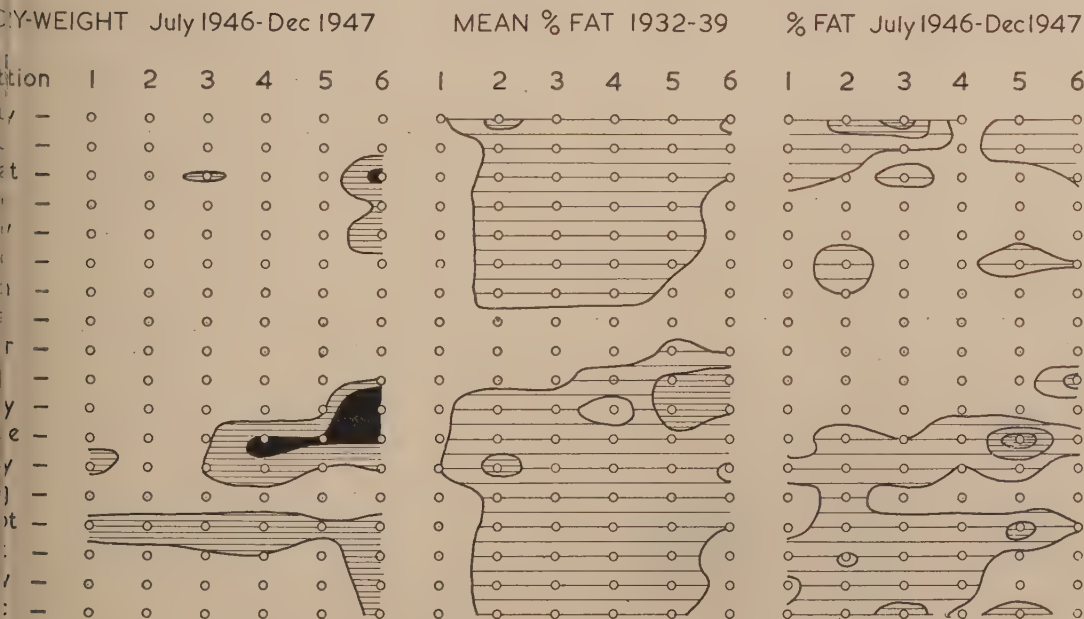


Figure 1. Total solids and percentage fat for Hensen-net hauls from six stations between Flam-borough Head (Station 1) and the SW. Patch of the Dogger (Station 6). The total solids are contoured at 0.05 (close lines) and 0.1 (black) grams per cubic metre and the percentages of fat at 10 (wide-spaced lines), 20 (medium spaced lines) and 30 (close spaced lines).

The Dry Weight and Fat Content of Plankton.

The fat content of dried Hensen-net samples from six stations between Flamborough Head and the SW. Patch of the Dogger Bank has been determined monthly since July 1932, except for the war period, by a method already described¹⁾. Since July 1946 the dry weight of these samples has also been obtained. This has been done by filtering the sample through a No. 1 Whatman filter paper of 12.5 cm. diameter and then drying the paper and contents to the colour and texture of a biscuit in the engine room of the ship, after which the sample in its paper was sealed up in a 1 lb. jar pending treatment ashore. In the laboratory the sample is dried at 80°C. for 48 hours and then weighed, the weight of the filter paper being subtracted. The weight is finally expressed as weight per metre

1) R. S. Wimpenny. Journal du Conseil. XIII, No. 3, p. 338, 1938.

cubed as a result of dividing the gross weight by the distance through which the net was and multiplying by the factor for the net which is approximately three.

These values are shown in Figure 1 for the months between July 1946 and December 1947 together with the corresponding monthly mean fat percentages taken in the period July 1939 to July 1939.

It is evident that the dry weight is greater in those months of 1947 which are comparable with those of 1946. This is also true of the fat content which is generally below the pre-war mean through most of the period.

The observations given here and others that have not been published, all referring to the summer months, show some correspondence with the difference in weight and condition which Dr. W. C. Hodgson refers to in connection with the East Anglian turn herring. The nature and extent of this correspondence is the subject of a further investigation.

R. S. Wimpenny

THE FISH.

Notes on the Occurrence of Fish Eggs and Larvae in the Southern Bight of the North Sea during the Winter of 1946—47.

By

A. C. Simpson.

DURING the winter of 1946/7 four quantitative plankton surveys were carried out in the Southern Bight of the North Sea and the eastern end of the English Channel as part of a programme of research concerned with the spawning of the plaice. While the surveys were planned to determine the distribution of the plaice eggs, considerable numbers of eggs and larvae of other species were caught and their numbers recorded. The information thus provided on the distribution and timing of the spawning of seven of these species, forms the material for this report. The data necessarily therefore, cover only a small part of the spawning areas of the different species and only the start of spawning in this area. It is anticipated that similar data will be available for publication from the plaice-egg surveys of the winter 1947/8 which will add to the value of the present material.

The details of the positions of stations, depths, hauls etc. will be published in the *Fisheries Investigations*, Series II, with the results of the spawning investigations, therefore the data presented here are presented only in summarised form on charts. At each station two vertical hauls were taken with the standard Hensen net from two feet above the bottom to the surface, by the method used by Buchanan-Wollaston (1914). The net filters a column $\frac{1}{3}$ square metre in section, therefore the total number of eggs and larvae of each species in each pair of hauls at each station has been multiplied by $\frac{3}{2}$ to give the number of eggs below one square metre of water surface. The figures shown on the charts are total numbers of eggs and larvae below one square metre of surface.

The winter of 1946—1947 was unusual in that between 28th January and 5th March there occurred

requent cold easterly and north-easterly gales caused considerable freezing of the sea along the Dutch coast, and reduced the temperature in the central Southern Bight from its usual 7°C. in January to 3.5°C. in March (6.5°C. being usual for March). The second January survey took place immediately before the cold weather, while the March survey was immediately following the worst of this weather. The chief effects of these conditions on the plaice in the Southern Bight was to prolong the time taken for eggs to hatch and apparently also to prolong the spawning period. This matter will be discussed at greater length in another paper; however, it is probable that the distribution of eggs and larvae on the March cruise will be at least slightly abnormal, and should be interpreted with

Whiting *Gadus merlangus* and Pout Whiting *G. luscus*. Charts 1—4.

Although the mean diameter of the eggs of *G. luscus* is smaller than that of *G. merlangus*, the range of diameters was found to overlap sufficiently to make it impracticable to distinguish the two. Fortunately however, the larvae of the two species are very distinct and wherever larvae of *G. luscus* were found the letter L. has been placed below the station position on the charts, and similarly wherever larvae of *G. merlangus* have been found the letter M. has been placed above the station position. At no station were there more than two *G. luscus* eggs per m.² while *G. merlangus* occurred in larger numbers, reaching 18 per m.², indicating that the eggs were also probably chiefly of *G. merlangus* unless some striking differential mortality was operating. Spawning of both species started on 26th December. The highest numbers (60—) were found during mid-January though they have been equally high in February when no survey was carried out.

The eggs and larvae occurred in largest numbers on the continental side of the sea area, though small numbers of eggs were also found on the western side. On each of the three cruises between 26th December and 28th January, the greatest concentrations of eggs were found near, and to the north of the North Hinder and Bligh Banks.

The December survey extended to the west of the positions shown on Chart 1 as far as the Cherbourg peninsula, and showed the presence of *G. luscus* and/or *G. merlangus* eggs as far west as Long. 10°W., but only south of Lat. 50°10'N.

The fact that that these two very closely related species spawn in the same area and at the same time, as indicated by the distribution of their eggs and larvae, is of considerable interest. Some hybridisation may be expected to occur, as occurs between the plaice and the flounder in the Baltic, unless there is a genetic mechanism which causes sterility of such hybridisation, or unless the association of males and females is very close during the expulsion of eggs and sperm.

B. Cod *Gadus callarias*. Charts 5—8.

The cod and haddock eggs are indistinguishable before the pigment is developed in the embryo, but as no haddock larvae or embryos were found, nor were there any landings of haddock by trawlers from the area, it is safe to assume that no haddock were spawning in the area.

Cod eggs were found in very small numbers in the December survey and occurred in increased numbers in subsequent cruises, the numbers found in March being as great as those found in January. Spawning occurred off shore but definitely towards the Dutch coast. The results agree with the observations of Redeker and Van Breemen (1908).

C. Dab *Pleuronectes limanda*. Charts 9—11.

A single egg of *P. limanda* was caught in the December survey and it is also seen that at the time of the first January survey spawning had scarcely started in the region, but by March the numbers of eggs were high, reaching 563. Again spawning was towards the Dutch coast, with little to the west. No eggs of *P. limanda* were caught in the English Channel, but the presence of eggs in the Straits of Dover on the second January survey indicates that spawning of *P. limanda* may occur further west in February.

In comparison with the large number of eggs, very few larvae were found on the March survey. This parallels a similar paucity among larvae of *P. platessa*, and may indicate an exceptionally high early mortality shortly after hatching for both species.

D. Flounder *Pleuronectes flesus*. Charts 12, 13.

A single flounder egg was found on the first January survey showing that spawning started in this area between the beginning and middle of January. Spawning at the time of the surveys was restricted even more closely to the Dutch side of the area than was found with the other species. No eggs of *P. flesus* were obtained in the English Channel or the Straits.

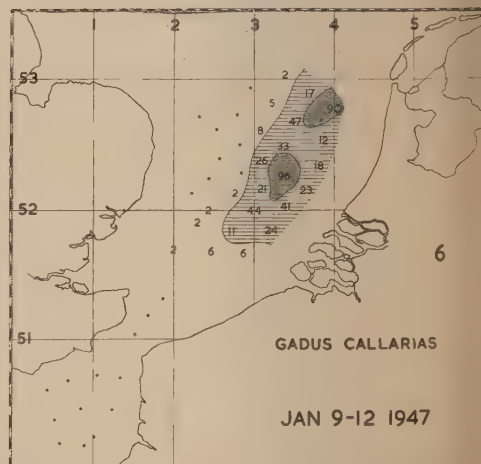
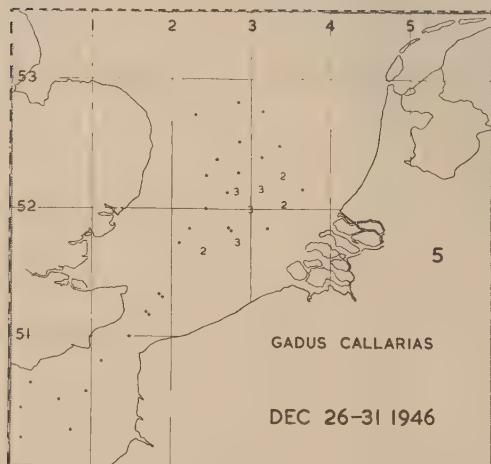
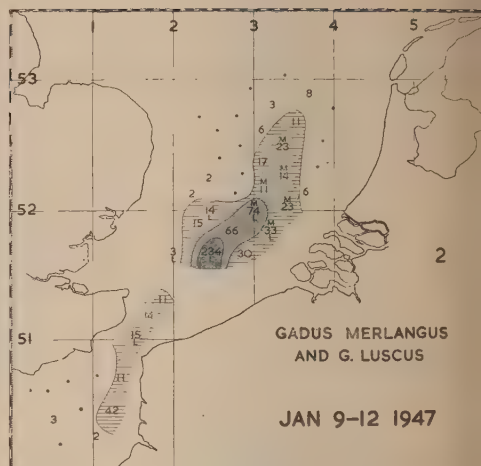
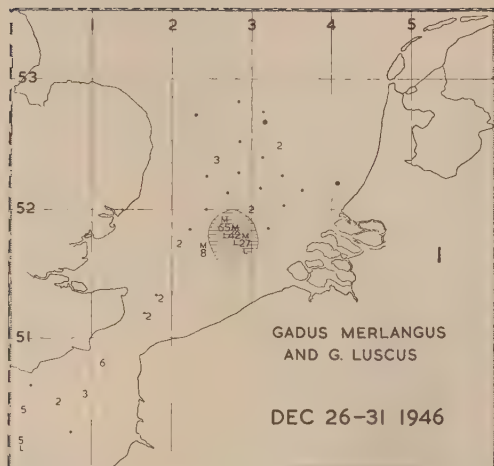
E. Sand Eel *Ammodytes marinus* Raitt.

Charts 14, 15.

The specimens of *Ammodytes* have been identified by Mr. G. P. Corbin of the Plymouth Marine Biological Laboratory, who finds, that they are all of the one species, *A. marinus*.

A single larva was found on the first January survey at a position in the Straits which 2 weeks later gave 453 larvae per m.². All the larvae caught at these stations in the Straits were very young with the yolk-sac still large, this also applied to many of the stations on the March survey and particularly the stations near the English coast.

The distribution is more readily seen from the charts than by description.



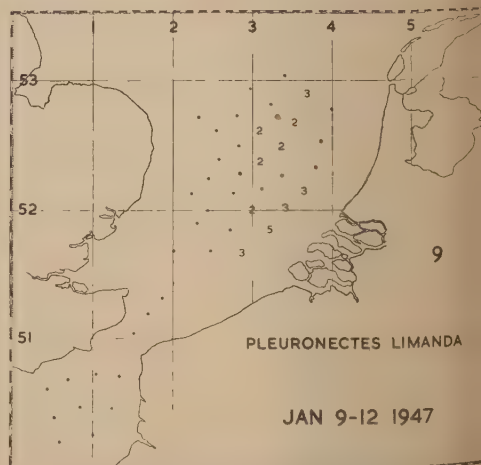
Legend to Charts 1—19.

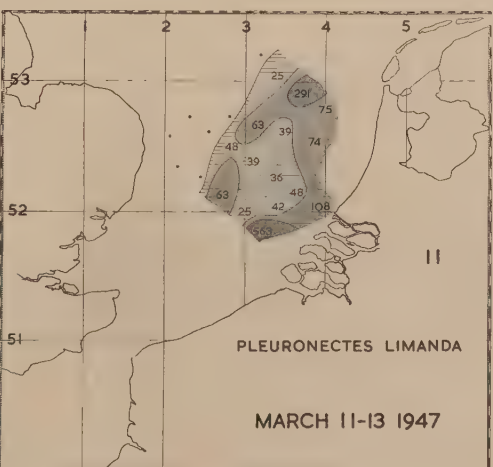
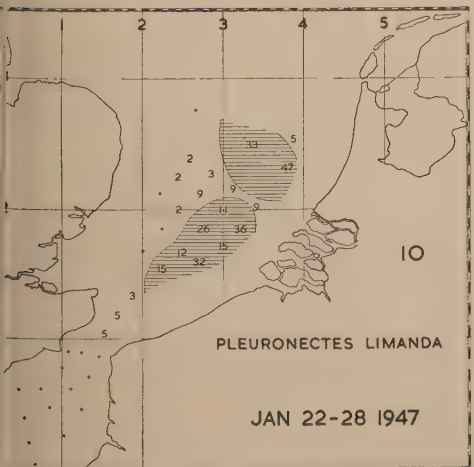
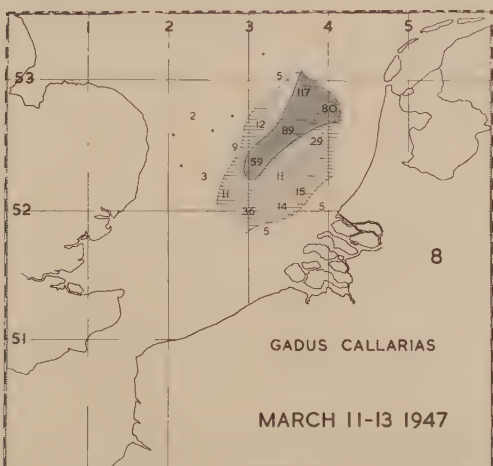
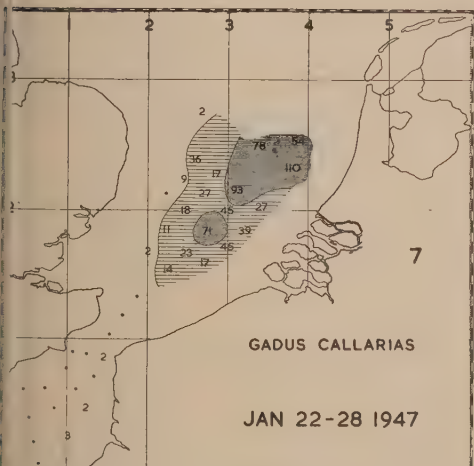
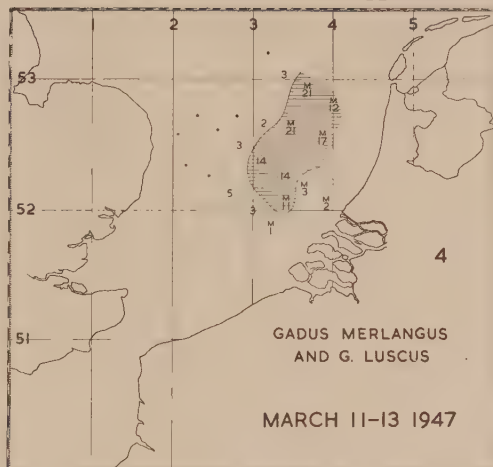
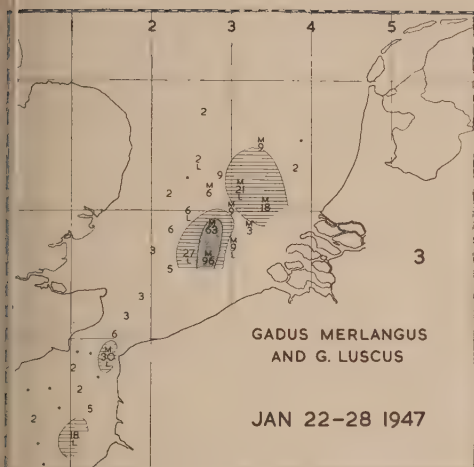
Each number on the charts gives the total number of eggs and larvae below 1 square metre of sea surface.

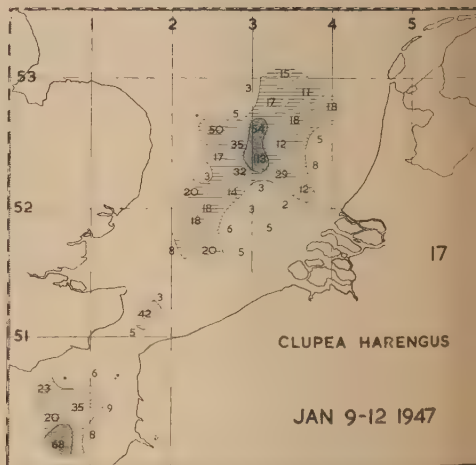
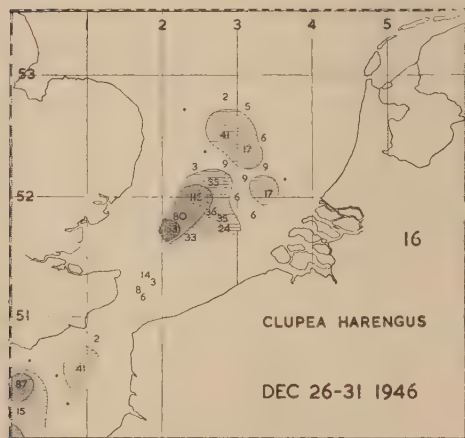
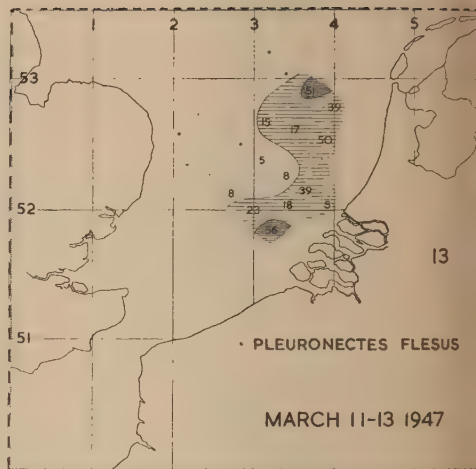
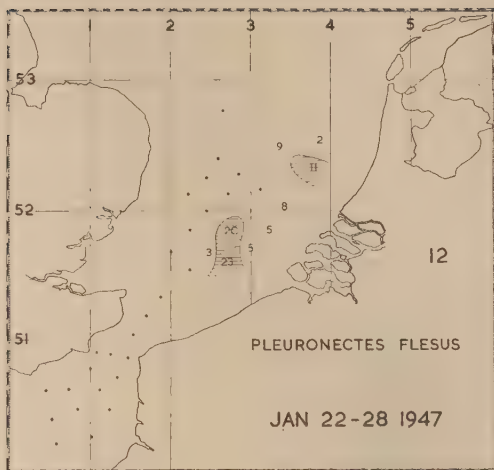
Positions of stations where no eggs or larvae were found marked •

Contours are shown at 10, 50 and 150 eggs and larvae below 1 m².

On charts 1—4 the letters L and M show stations where larvae of *G. luscus* and *G. merlangus* respectively were present.







F. Herring *Clupea harengus*. Charts 16—19.

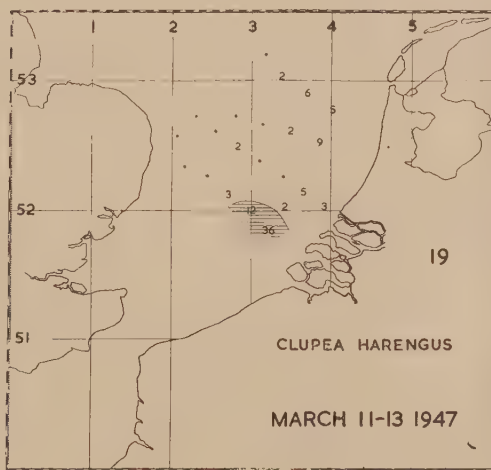
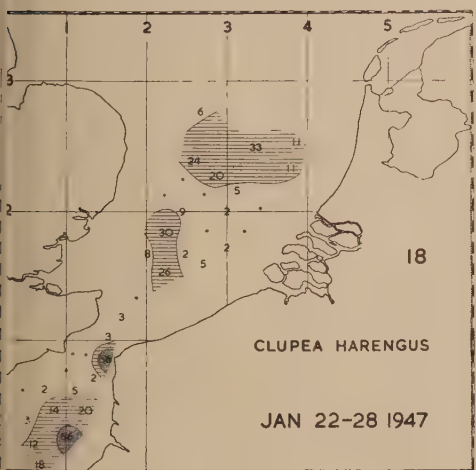
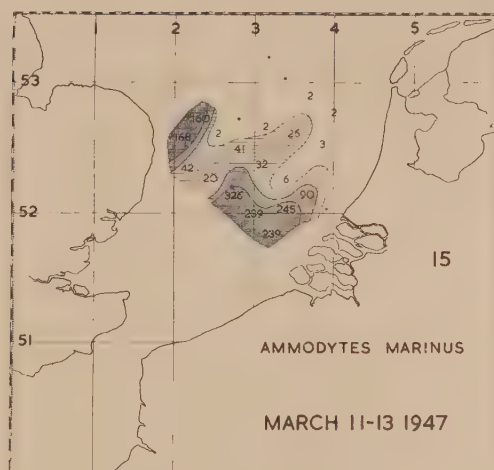
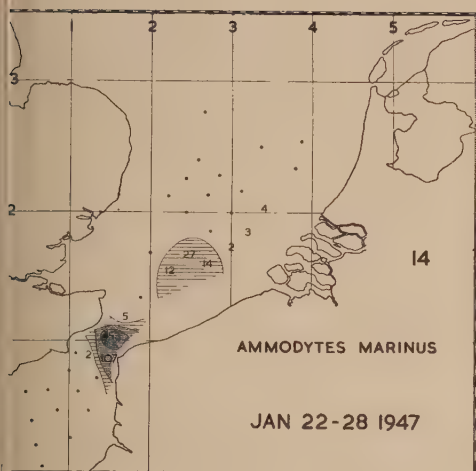
The vast majority of herring larvae were between 9 and 11 mm. long, but occasionally individuals were caught of lengths up to 16 mm. On the December survey herring larvae were found in numbers up to 20 per m.² as far west as 1°W. in the deeper water in the Channel.

G. Other Species.

Apart from the seven species described here and the plaice only very small numbers of eggs of a few other species were found.

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The Dutch Fishery for demersal Seafish in 1947.

By

L. K. Boerema and M. C. Cox-Heikens.

THE figures of the Dutch landings of demersal seafish give a fairly good picture of the decline of the catches since 1945 and our contributions on this subject in Vol. II and III of this series are being continued here.

As in the previous papers, Table 1 shows the total landings and their composition at IJmuiden. The total amount landed has somewhat decreased as compared with 1946, particularly as a result of the diminished returns of plaice and sole. The catches

of haddock and cod have risen due partly to more of the vessels fishing in the northern part of the North Sea in 1947. In all these species the landings of the smaller individuals have increased and of the bigger decreased.

In Table 2 are given the numbers of days absence, the total quantities of the fish landed and the quantity of fish landed per days absence of the steam trawlers. It is not possible to give the figures for the motor luggers and the small motor vessels

Table 1.
Quantities (in tons) of Demersal Fish landed in 1947
at the Port of IJmuiden.

Species	Market categories	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill		5.4	22.4	12.3	2.6	42.7
Cod	Large >72 cm.	517.0	993.9	390.5	253.6	2,154.9
	Small I 55—72 cm.	577.5	659.9	70.6	37.7	1,345.7
	Small II 35—55 cm.	989.2	539.2	130.9	58.1	1,717.4
	Small III <35 cm.	299.3	237.8	25.9	22.7	585.7
Total		2,383.0	2,430.8	617.8	372.1	5,803.7
Dab		125.0	260.7	171.7	118.8	676.2
Flounder		19.4	31.5	40.2	9.4	100.4
Gurnard and Latchet		7.2	203.5	81.9	33.0	325.7
Haddock	Large >50 cm.	5.9	40.6	37.0	30.9	114.5
	Large medium 44—50 cm.	5.7	32.9	40.3	62.5	141.4
	Small medium 37—44 cm.	11.8	114.0	182.3	256.2	564.3
	Small I 30—37 cm.	11.8	112.0	356.2	571.9	1,051.9
	Small II 25—30 cm.	67.0	1,283.3	1,998.6	1,122.0	4,470.8
	Small III <25 cm.	—	0.4	0.1	—	0.5
Total		102.2	1,583.1	2,614.4	2,043.6	6,343.4
Hake		1.4	139.2	71.6	20.6	232.9
Ling		3.1	17.3	13.0	18.2	51.6
Plaice	Large >50 cm.	226.9	64.5	39.4	39.9	370.6
	Large medium 40—50 cm.	189.3	147.6	110.7	38.3	485.9
	Small medium 35—40 cm.	138.2	215.4	202.1	52.9	608.7
	Small II 27—35 cm.	341.6	607.0	887.0	127.4	1,963.0
	Small III 21—27 cm.	82.1	588.1	693.7	115.6	1,479.6
Total		978.2	1,622.6	1,932.9	374.1	4,907.8
Saithe		2.8	122.1	247.7	127.5	500.2
Sole	Large >37 cm.	19.6	67.6	23.4	12.0	122.6
	Large medium 32—37 cm.	40.0	191.9	69.8	35.8	337.6
	Small medium 29—32 cm.	11.5	82.1	29.4	12.4	135.4
	Small I 26—29 cm.	6.5	24.6	13.2	7.8	52.0
	Small II 23—26 cm.	2.8	9.6	10.2	5.3	28.0
	Small III 15—23 cm.	1.1	6.9	6.9	0.8	15.7
Total		81.6	382.7	152.8	74.1	691.3
Turbot		37.1	228.8	169.2	51.1	486.2
Whiting		1,381.9	1,467.2	489.7	389.9	3,728.7
Other Species		41.6	151.9	84.8	60.9	339.2
Total		5,169.9	8,663.9	6,700.1	3,695.8	24,229.8

motor luggers was 5,895 tons, and by the small vessels 5,095 tons.

The figures of the catch per days absence of the steam trawlers show first a considerable rise in 1947 and then a fall below the level of 1946 (Table 2 and Fig. 1). The mean for 1947 lies above that of 1946. The numbers of days absence do not give a good impression of the total activity of the Dutch trawler fleet as a great number of trawlers occasionally landed their catches in England. The number of landings in England varied between 4 and 23 in the different months, the total number in 1947 being 153. The mean number of days absence of these voyages was 11.

Table 2.
Catch of the Steam Trawlers fishing
from the Port of IJmuiden in 1947.

Month	No. of days absence	Quantity landed (tons)	Quantity per days absence (kg.)
January	244	605	2,479
February	174	515	2,959
March	320	1,522	4,755
April	519	2,022	3,894
May	391	987	2,500
June	609	1,707	2,803
July	616	1,852	3,006
August	284	721	2,540
September	142	277	1,950
October	170	275	1,621
November	229	292	1,277
December	541	1,228	2,270
Total year	4,239	11,993	2,829

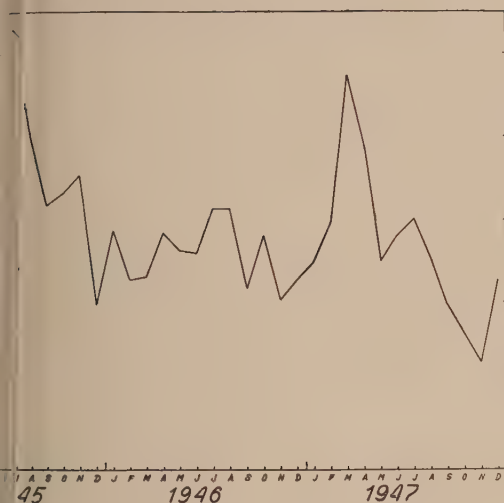
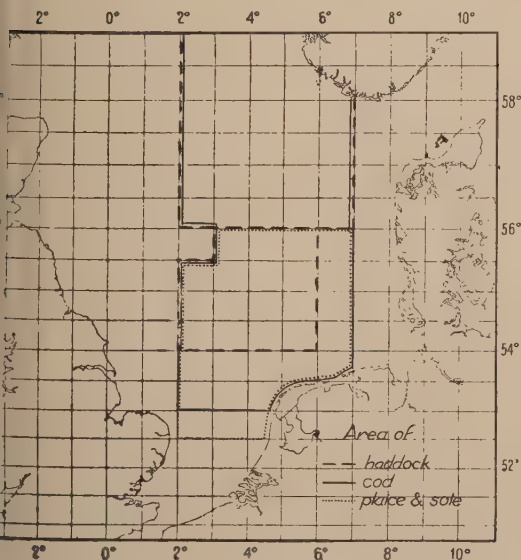


Fig. 1. Total Catch per Days Absence by Dutch Steam Trawlers.

was done in Table 2 in Ann. Biol. III for the 1946 as for these vessels it has not been possible to separate the voyages with the ordinary trawl from those with the herring and shrimp trawl. The general impression is that the number of voyages is lower and the catch per voyage higher than in 1946. This is undoubtedly due to a further increased capacity of these vessels, resulting in longer voyages. The total catch of demersal fish by the



2. Areas from which the mean catch per 100 hours Fishing is calculated.

For the purpose of investigating the changes in the density of the fish stock in more detail, we have divided the North Sea into different areas for the different fish species (Fig. 2). For each of these species we have calculated the mean catch per 100 hours of the steam trawlers in their area in each month throughout the years. We could not use the mean figures per 100 hours fishing of the whole trawler fleet without a correction because there has been a tendency to fish progressively further north since 1945. This would give decreasing figures for such southern species as plaice and sole and increasing ones for such northern species as haddock, supposing that the density of the population had remained constant. Therefore we used the method just mentioned. In the corresponding contribution in Ann. Biol. III this method has not been used, and consequently the results are less accurate.

In Figures 3—6 the average catches of the different species are shown graphically.

The catches of **cod** show a remarkable course. After very big catches in June—July 1945 a sharp decline followed with regular fluctuations. Very

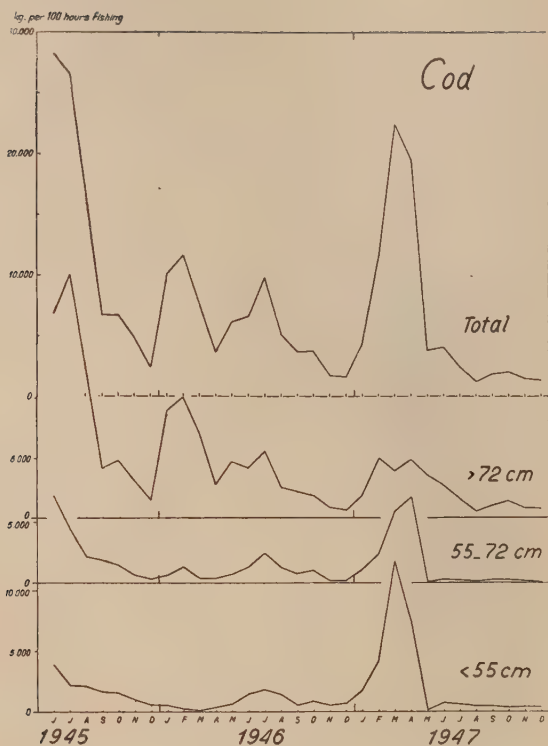


Fig. 3. Catch per 100 hours Fishing. Cod.

heavy catches were made again in February—April 1947. As Fig. 3 shows, the catches of the large cod are steadily diminishing. The exceedingly high peak in February—April 1947 is mainly caused by the smaller and the smallest categories. This might be explained by the severe winter, driving the smaller cod out of the shallow coastal waters where they normally live, and concentrating them in the deeper waters where the trawlers were fishing. It is noteworthy that the Texel cutters fishing nearer to the coast than were the trawlers, caught much less cod in these months than in the same months of 1946. Perhaps still other factors played a part as in the northern North Sea also the catches of small cod were high in these months. If we neglect these abnormal months the general trend of the density of the cod is downwards.

For the haddock (Fig. 4) the case is somewhat different. During the summer this species is caught principally south-east of the Dogger Bank, and during the winter north of the Great Fisher Bank. We have constructed our graphs in the following way. We give the mean catch per 100 hours fishing in the southern area for the months June—October and the same in the northern area for the months November—May (Fig. 4). We do not know where

our trawlers fished before October 1946, but may take it for certain that most of them have fished in the southern North Sea in that period, except perhaps in some winter months. We cannot compare directly the graph for the period before October 1946 with that for the subsequent period without taking into account the fact that the first part of the curve will be too low.

So we may conclude that the density of the haddock above 44 cm. has decreased considerably. Haddock between 30 and 44 cm. shows a decline in the summer catches and also in the winter catches from winter '46—'47 to winter '47—'48. Perhaps there has been an increase in the winter density from '45 to '46—'47. The catches of the smallest haddock, between 25 and 30 cm., show quite another picture. The density of the smallest category has much increased from 1945 until 1947. Then, however, the catches in northern North Sea show a decline from winter '46—'47 to winter '47—'48. The interpretation will be as follows. During 1947 a very good year-class grew into the fishery. Due to this year-class has been fished away faster than new recruitment took place. The density of the haddock stock has been much influenced by

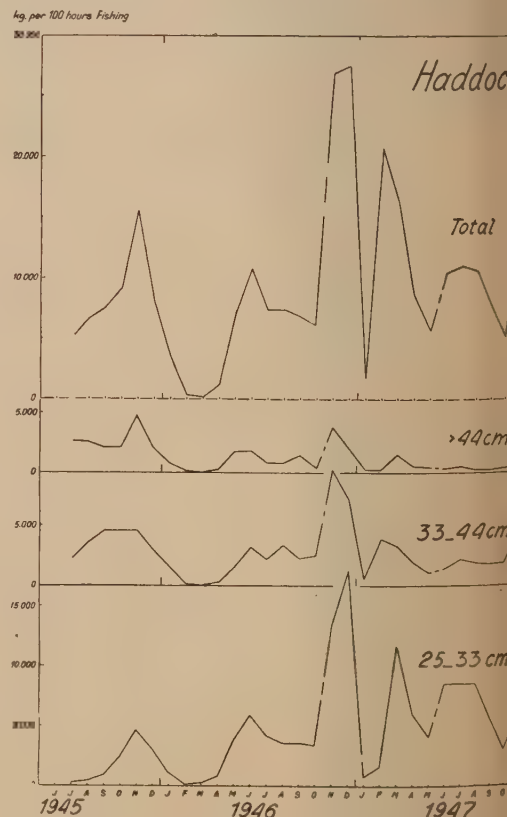


Fig. 4. Catch per 100 hours Fishing. Haddock.

ary, but the decline has to a large extent been compensated by the recruitment of a very good year-class entering the fishery in 1946 and 1947. Fig. 5 gives the course of the plaice fishery. The line shows a heavy but diminishing decline. The figure shows that this decline took place in all different market categories.

The decline in the density of the sole is still very serious (Fig. 6). The severe winter 1946—1947 will have influenced this to a large degree. Here also the market conditions have played a part. As the prices of sole were relatively very low, the fishermen preferred to fish for more abundant species in 1947. This in itself would have involved a decline of the figures, but it cannot be the cause of the very serious diminution of the catches. The relative extents of the effects of the severe winter and the fishing intensity cannot be evaluated.

Table 3 gives the mean catch per 100 hours fishing of the different fish species in their areas in 1946 and 1947.

The general conclusion is that the density of nearly all the fish species has decreased considerably. That the mean catch of all species together is higher in 1947 than in 1946 is caused by the normal catches of small cod in the first months of the year, by the big catches of small haddock and the preponderance of these species in the average of the catches. Furthermore we must take into account that the fishing capacity of the trawler fleet increased: 23 small trawlers (below 200 tons) in 1946, 13 trawlers of medium capacity

Table 3.
Mean Catch per 100 hours Fishing (in kg.)
of the Steam Trawlers at IJmuiden.

	1945	1946	1947
Cod			
> 72 cm.	5,651	5,026	2,381
55—72 cm.	1,501	1,241	1,530
35—55 cm.	1,173	818	1,714
< 35 cm.	144	108	614
Total	8,469	7,194	6,238
Haddock			
> 44 cm.	2,709	778	430
37—44 cm.	2,610	1,025	1,018
30—37 cm.	1,507	835	1,444
25—30 cm.	2,374	3,432	7,504
< 25 cm.	14	29	113
Total	9,214	6,100	10,509
Plaice			
> 35 cm.	2,713	1,528	860
27—35 cm.	2,239	1,054	590
< 27 cm.	189	172	99
Total	5,140	2,754	1,549
Sole			
> 32 cm.	439	261	62
29—32 cm.	134	73	9
26—29 cm.	38	22	4
23—26 cm.	5	4	1
15—23 cm.	1	1	—
Total	617	360	75

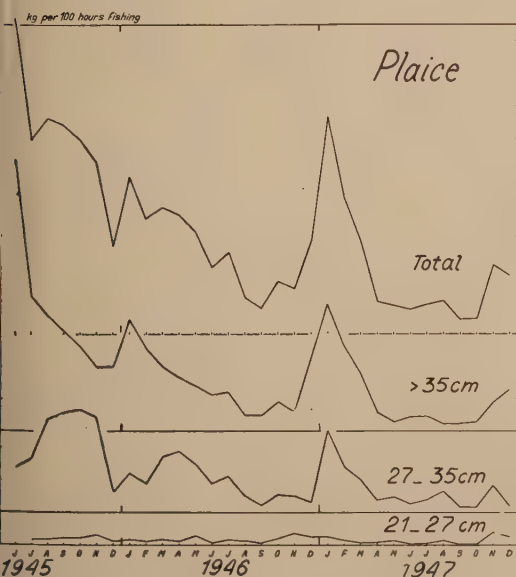


Fig. 5. Catch per 100 hours Fishing. Plaice.

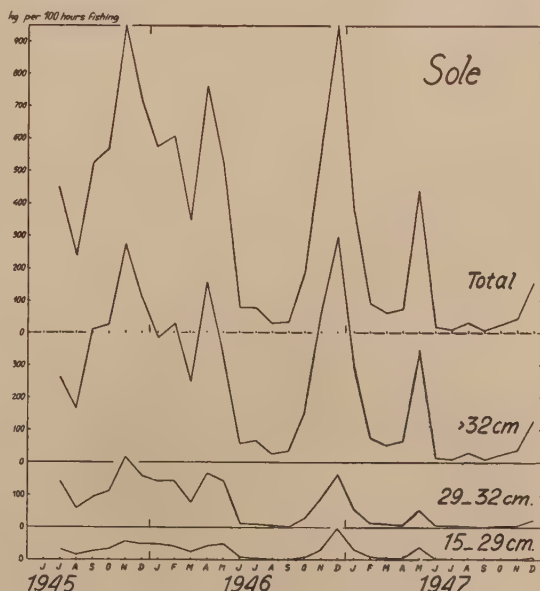


Fig. 6. Catch per 100 hours Fishing. Sole.

**Table 4. Percentage of Total Quantity landed to the Class "Small",
at the Port of IJmuiden in 1947.**

	Cod < 72 cm.	Haddock < 37 cm.	Plaice < 35 cm. < 27 cm.		Sole < 29 cm. < 26 cm.	
1st Quarter	78	77	43	8	13	4.9
2nd Quarter	59	88	74	36	11	4.3
3rd Quarter	37	90	82	36	20	11
4th Quarter	32	83	65	31	19	8
Total year	63	87	70	30	14	6.3
1946	29	64	58	19	9	2.5

(200—300 tons and 350—500 h. p.) and 1 big trawler (above 300 tons and 500 h. p.) were fishing in 1946. For 1947 these figures were 21, 16 and 10. *Therefore the real decrease in the density of the fish stock will be still bigger than our graphs show.*

Together with this decrease and in accordance with what we have seen after the first world war, the percentage of smaller fish has increased, in some species very much, as is shown by Table 4. However, as we have shown in the discussion of the graphs in the case of the haddock and the cod, the rise in the percentage of small fish is not only due to the fisheries. In the haddock we must have had a good recruitment of a new year-class and in the cod we saw the influence of the severe winter.

In the coastal area the catches also have diminished. The landings at the port of den Helder have been less than in 1946 (Table 5). This was especially the case with the landings of cod, large plaice, sole and whiting. This will partly have been caused

by the fact that only a few voyages were made the first months of 1947. Some other species of small plaice have increased. Table 6 shows that the percentage of small plaice has somewhat risen in this area.

**Table 6.
Percentage of Total Quantity landed to
the Class "Small" at the Port of den
Helder in 1947.**

	Plaice < 35 cm. < 27 cm.	
1st Quarter	77	48
2nd Quarter	84	55
3rd Quarter	87	54
4th Quarter	87	57
Total Year	85	54
1946	77	49

**Table 5. Quantities (in tons) of Demersal Fish landed in 1947
at the Port of den Helder.**

Species	Market categories	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total Quantity
Brill		0.7	8.6	5.6	2.7	17.6
Cod		38.2	14.6	2.7	8.1	63.7
Dab		17.9	82.2	47.5	38.7	186.4
Flounder		2.4	19.9	34.9	17.7	75.0
Plaice	Large, Large medium and					
	Small medium	36.4	59.8	45.8	26.3	168.3
	Small II	46.2	112.8	109.9	63.3	332.3
	Small III	77.3	211.7	185.3	119.5	593.8
	Total	159.9	384.3	341.1	209.1	1,094.4
Sole		9.7	109.6	86.3	42.2	247.7
Turbot		2.1	11.6	12.8	6.2	32.7
Whiting		55.2	43.1	12.9	40.3	151.5
Other species		0.8	40.6	19.4	36.8	97.6
Total		286.9	714.6	563.4	401.7	1,966.5

lice.

The Danish Plaice Fishery in the North Sea.

By

Aage J. C. Jensen.

In previous years the market-investigations at Esbjerg carried out from Dr. Tåning's Department of "Kommissionen for Danmarks Fæderlige og Havundersøgelser" makes it possible to follow the changes in the stock of commercial plaice.

Density of the Stock.

Table 1. Mean Weight per landing (tons).
(in brackets number of landings).

Year	C 2, north-east	Dogger Bank	Northern Edge of Dogger, 40—60 m.
192—39	2.2 (55)	2.0 (34)	2.7 (17)
40	11.1 (8)	9.9 (7)	—
41	—	—	—
42	4.3 (21) ¹⁾	5.7 (18)	5.2 (9)
43	4.2 (3) ²⁾	1.6 (4)	6.4 (5)
44	3.3 (9)	2.0 (2)	3.8 (2)

¹⁾ 3 very small landings excluded while the small ones may be due to abnormal conditions (e.g. bad weather). If they are included the mean is 3.8 (24).

²⁾ 1 landing partly from C2, north of Dogger included. If it is excluded the mean is 3.8 (2).

It is seen from Table 1 that the mean size of the landings from the area C2 north-east, i. e., the part C2 lying between 55°N. Lat. and 56°N. Lat. and the east of 5°E. Long. (K9, K10, L9, L10) as well as from the northern edge of the Dogger Bank was 50% greater than the mean of the pre-war years, while the mean weight of the landings from the Dogger Bank was the same in 1947 (and 1946) as in pre-war years.

The mean weight of landings also from other areas (including the years 1940—42) down to 1946 is given in Rapp. et Proc.-Verb. Vol. No. 122, Fig. p. 21.

During the summer months of 1947 there were many complaints from the fishermen that the catches of plaice were very poor especially in the areas

to the east and south-east of the Dogger Bank. This apparent scarcity of the stock seems partly to be due to the exceptionally low bottom temperature during the summer stated in this area (see p. 89), on account of which many of the plaice undoubtedly have been buried in the bottom.

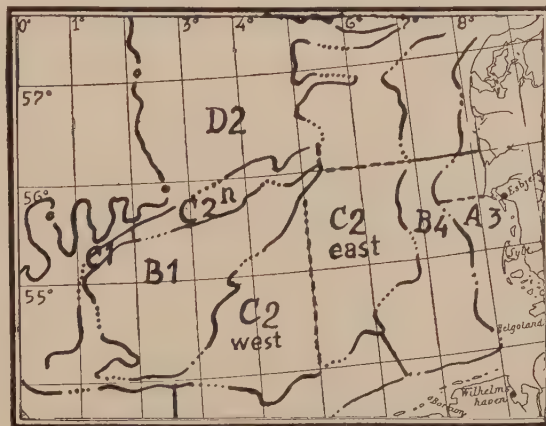


Fig. 1. Chart showing Areas.

Length Distribution.

When comparing the length distribution of the plaice caught approximately at the same place and time in 1945 and 1946 respectively, it was found in Ann. Biol. Vol. III that in many places an increase of the mean length had taken place from 1945 to 1946. Yet an examination of the whole material at hand shows that in all areas covered by the Danish investigations the mean length increased during the war, and that in some areas a reversion towards the state of 1932—38 was found in 1946. In Table 2 the length distribution in 1947 is compared with the length distribution partly in the years 1943—46, partly in the pre-war years.

Table 2.
Length Composition of Catches.

East and South-East of Dogger Bank, 40—60 m., Dogger Bank and Northern Edge of Dogger. Percent

Year	Month	Depth m.	No. of Catches	Centimetres							
				27/30	31/35	36/40	41/45	46/50	51/55	56/60	61/65
Area C2, north-east.											
1932—38	VIII—IX	38—55	37	48	39	11	0.8	0.6	0.2	0.1	—
1943	IX	43—45	3	40	54	5	0.7	0.2	—	—	—
1945	VIII—XI	42—51	5	32	22	22	19	4	0.9	0.3	—
1946	VII—X	45—47	3	52	38	9	1	—	—	—	—
1947	X	40—60	9	46	40	11	2	0.8	0.2	—	—
Area C2, south of 55°N. Lat.											
1932—38	XII—IV	40—50	27	63	25	8	3	0.9	0.2	0.1	—
1935—36	IX—XI	42—51	10	46	39	11	3	0.6	0.1	0.3	—
1945	X—XI	46—47	4	5	46	42	6	1	—	—	—
1946	IV	38—42	3	5	34	31	18	10	2	0.2	0.2
1947	III	40—46	3	13	52	26	6	0.6	0.1	—	—
1947	X	40	1	5	47	39	6	3	0.5	—	—
Dogger Bank, east of 3°E. Long.											
1934—38	IV—V	33—36	3	27	28	24	13	5	2	1	0.4
1946	IV	33—38	3	5	33	36	19	7	—	—	—
1947	III	37	1	24	44	24	7	0.6	—	—	—
1934—38	VIII—XI	28—38	11	27	50	10	9	3	0.6	0.2	0.1
1943	IX	32—36	7	2	25	48	18	6	1	0.2	—
1945	VIII—XI	30—35	10	2	27	40	20	8	2	1	0.1
1947	X	29	1	32	62	4	0.8	0.4	0.1	0.1	—

It is seen that in the northern part of the C2, north of 55°N. Lat. on the Dogger and at the northern edge of the Dogger the average length of the plaice fished had decreased to the effect that the length composition was now about the same as in

pre-war years. On the other hand, in C2, south of 55°N. Lat., the average length of the plaice fished in 1947 seems to be much greater than in the pre-war years.

Preliminary Results of Marking Experiments on Plaice in the Central North Sea 1946 and 1947.

By

A. Vedel Tåning.

MARKING of plaice was carried out on fish caught by Danish Seine and immediately liberated on the locality where fished. The fishes liberated were accordingly very lively and of high viability. The sizes marked being mostly 30—50 cm.

In 1946: 1398 were liberated in May—July.

In 1947: 799 were liberated in May,
806 in July—August and
500 in October.

Total: 2105.

From pre-war years we have some experiments from 1932—33 (Doggerbank markings) carried exactly in the same way as the afore-mentioned these experiments are of some value for comparing the fishing intensity in pre- and post-war time. Most interest at present is naturally the information obtained by these experiments on the fishing intensity in 1946 and 1947 compared with that in pre-war period.

The following tables show the results from experiments; they exhibit such uniformity from marking locality to another; that it is justified

Table 1.
Number and Percentages of Recoveries during first 180 days.

Area marked Days	A. Doggerbank.						B. Central North Sea.			
	Exp. 1932-33 (June-July) 303		Exp. 1946 (May, July) 687		Exp. 1947 (May, July) 822		Exp. 1946 (May, July) 1398		Exp. 1947 (May, July-Aug.) 1405	
	No. rec.	%	No. rec.	%	No. rec.	%	No. rec.	%	No. rec.	%
1.—30.	72	23.8	65	9.5	162	19.7	116	8.3	190	13.5
1.—60.	24	10.4 ¹⁾	55	8.8	57	8.6	98	7.6	105	8.6
1.—90.	18	8.7	28	4.9	29	4.8	77	6.5	53+	4.8+ ²⁾
1.—120.	4	2.1	31	5.8	24	4.2	60	5.4	50+	4.7+
1.—150.	2	1.1	24	4.7	17	3.1	43	4.1	33+	3.3+
1.—180.	0	0.0	10	2.1	3	0.6	17	1.7	5+	0.5+
First half year	120	39.6	215	31.3	292	35.5	413	29.5	438	31.2+
First year	151	49.8	246	35.8	—	—	(+2?) 478	34.2	(+2?) —	—
Total rec. p to 1.2.1948	170	56.1	276	40.2	300	36.5	(+5?) 534	38.2	447	31.8

¹⁾ Percentage of recaptures for each month is calculated after subtraction of the number recaptured during the previous month.

²⁾ More recaptures expected.

consider them rather reliable as a measure of the present fishing intensity in the central part of the North Sea, where much of the Danish seine fishery is placed.

Table 1A shows that the percentage of recapture in experiments on the Doggerbank rises from 1936 to 1947 — in 1946 about 23 % was obtained during the first three months, in 1947 the same percentage was reached in less than two months; in pre-war years the same percentage was however obtained during the first month after marking. The post-war percentage of recaptures will probably by the present increasing fishing intensity be reached during 1948—1949. The enforced rather high minimum weight of plaice landed during part of the war in England (equal to about 30—33 cm. length) is of course the effect that the stock of larger plaice is being thinned out rapidly.

Table 1B gives further particulars of all the experiments carried out in 1946 and 1947; it shows *inter alia* that about $\frac{1}{3}$ of the marked plaice were recaptured during the first half year, with a slightly higher percentage in 1947 than in 1946.

Table 2 gives the recapture percentage in the first six months after marking specified for various areas (of 1° Lat. and 2° Long.) and for 1946 and 1947 respectively. Some difference is present in the various areas of the central North Sea, but generally we find a rise from 1946 to 1947 in most areas.

As in pre-war years the highest percentage of recaptures is due to the Danish seiners, being about 83 % in the 1946 Doggerbank experiments and 86 % in the 1947 Doggerbank experiment, as against about 77 % in pre-war time.

Table 2. Number and Percentages of Recaptures during first 6 months.
Central North Sea according to Areas.

Areas	Exp. 1946 (May, July)			Exp. 1947 (May, July—Aug.)		
	No. marked (No. Stat.)	Rec. first 1/2 year No.	%	No. marked (No. Stat.)	Rec. first 1/2 year No.	%
A 55—56°N. 6—8°E.	200 (2)	51	25.5			
B " 4—6°E.	219 (3)	75	34.2	350 (2)	72	20.6
C " 2—4°E.	280 (4)	80	28.6	364 (2)	127	34.9
D ₁ " 0—2°E.	100 (1)	33	33.0	171 (1)	70	40.9
D ₂ 54—55°N. 0—2°E.				111 (1)	41	36.9
E " 2—4°E.	399 (4)	130	32.6	90 (2)	22	24.4
F " 4—6°E.	200 (2)	44	22.0	297 (3)	106	35.7
Total	1398	413	29.5	1383	438	31.7

Table 3.
Recaptures (No. and %) in the Doggerbank Experiments
according to the Nationality of Fishing Vessels up to 1.2. 1948.

	No. marked	No. recaptured	% rec. by vessels from		
			Denmark	England	Other Countries ¹⁾
Exp. 1932—34	1824	408	77	19	4
Exp. 1946	687	276	83	10	7
Exp. 1947	822	296	86	13	1

¹⁾ Holland, Germany, Norway, Faroes.

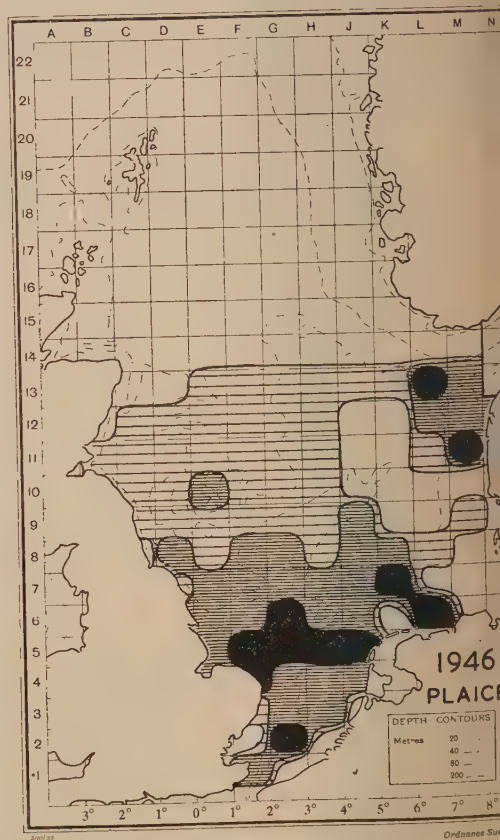
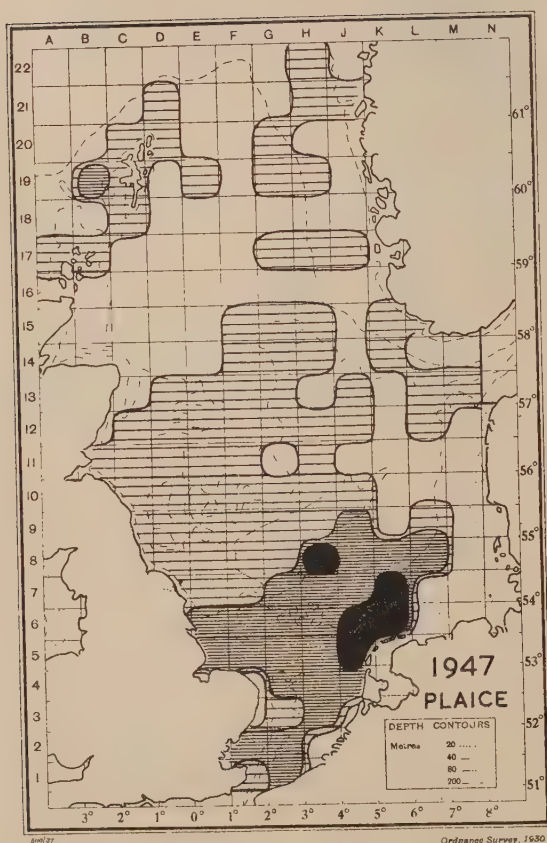


Fig. 1. Charts showing the Origin and Catch-Density of Plaice caught by English steam trawlers in 1946 (right) and by English or Scottish Steam Trawlers in 1947 (left). The wide-spaced lines represent fishing up to 50 cwt. per 100 hours, the close-spaced lines from over 50 up to 100, and the black areas over 100 cwt. per 100 hours fishing.

The English Plaice Fishery in the Southern North Sea and Neighbouring Waters in 1947.

By

R. S. Wimpenny.

THE area covered by English steam trawlers in 1947 was not widely different from that of the previous year, although the catch per unit of time was lower. This is brought out in Figure 1, where the positions in respect of 1946 and 1947 are displayed side by side. The number of 100-ton class trawlers rose during the year at Grimsby from 160 to 176, the average of 165 being substantially higher than the previous year. The numbers coming from Lowestoft in the first weeks of January, April, July and October were 92, 95, 83 and 73 respectively, a decrease when compared with the year before. Corresponding figures for the inshore motor trawlers of the Rye Bay area were 41, 61, 44 and 48. These also show a decrease compared with 1946.

Size.

Measurements were continued on the markets at Grimsby, Lowestoft, Rye and Hastings as in 1946, the data from the North Sea being divided into the Grimsby and Lowestoft landings and the two areas mentioned in last year's report on this fish. The data have also been analysed by sex for this year, but as the whole material available represents extensive and cumbersome tabulation it has been omitted at the Fisheries Laboratory, Lowestoft, since it may be obtained on demand. Figure 2, which is derived from this data, gives the length frequencies of plaice each quarter for Rye Bay and the two North Sea areas. It is directly comparable with Figure 3 in last year's contribution. (See *Ann. Biol. III*, p. 62). The winter quarter for Rye Bay shows that larger fish were being caught here in 1947 than in any year since the observations began. (See *ibid.* II, p. 69). In the next two quarters the fish became successively smaller and were smaller than in the previous year. The October sample, however, showed an increase in size instead of the usual decrease to the annual minimum.

For two areas of the North Sea (Figure 2) the results more northerly resembled last year in showing that the fish were generally longer than further south. In both areas the smallest fish were taken in the winter quarter and in contrast to 1946 the principal mode for both these samples was at 25–26 cm.

The appearance of recruits at these sizes is strikingly similar to what was shown in October 1946 for the inshore fishery of Rye Bay. It seems likely that this later arrival of recruits in the North Sea may be due to the lower growth-rate of young plaice which has been suggested for this area.

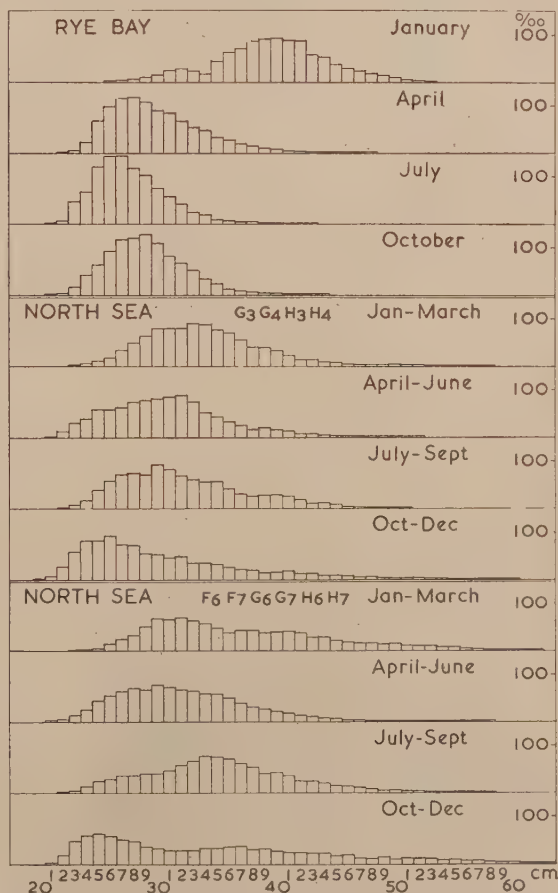


Fig. 2. Frequency Histograms showing the Length Distribution of Plaice from Rye Bay and two areas of the North Sea for each quarter of 1947.

Table 1.

Rye Bay Plaice. Age Composition of Rye Bay Plaice in 1947.

By numbers and $\%$ with respect to average length S.(L), average weight, relation between length and weight, number of fish examined, estimated weight (cwt.).

Age-Group		I	II	III	IV	V	VI	VII	VIII	IX+	Total
No. of fish examined	♂	27	180	78	42	16	18	9	8	3	381
	♀	25	228	101	44	14	13	25	20	31	501
	Total	52	408	179	86	30	31	34	28	34	882
$\%$	♂	7.1	47.2	20.5	11.0	4.2	4.7	2.4	2.1	0.8	—
	♀	5.0	45.5	20.1	8.8	2.8	2.6	5.0	4.0	6.2	—
	Total	5.9	46.2	20.3	9.7	3.4	3.5	3.9	3.2	3.9	—
Estimated No. (in 1000's) of fish landed	♂	34.1	288.9	136.6	74.8	33.0	36.8	21.7	18.4	8.3	652.6
	♀	28.4	370.3	170.8	78.9	31.6	25.3	48.3	40.7	64.6	858.9
	Total	62.5	659.2	307.4	153.7	64.6	62.1	70.0	59.1	72.9	1,511.5
Estimated weight (cwt.)	♂	119	1249	622	327	170	198	144	119	51	2,999
	♀	108	1815	1034	507	219	170	392	390	804	5,439
	Total	227	3064	1656	834	389	368	536	509	855	8,438
Average weight (g.)	♂	165	220	237	236	259	269	330	328	—	—
	♀	180	255	315	324	361	348	428	503	—	—
	Total	172	239	281	281	307	302	402	453	—	—
Average length (cm.)	♂	25.6	27.7	28.9	28.9	30.6	31.4	33.8	34.0	—	—
	♀	30.0	28.6	31.1	31.8	32.6	33.4	36.0	38.4	—	—
	Total	25.8	28.2	30.1	30.4	31.5	32.2	35.4	37.1	—	—
S. (L.)	♂	2.03	3.06	2.44	2.61	—	—	—	—	—	—
	♀	2.29	3.41	3.27	2.72	—	—	—	—	—	—
	Total	2.15	3.29	3.12	3.02	2.99	3.12	3.13	4.23	—	—

Comparison between Weight and Length $W = CL^n$.

	I	II	III	IV
♂	0.02816 $L^{2.6709}$	0.02859 $L^{2.6817}$	0.01674 $L^{2.8370}$	0.02068 $L^{2.7698}$
♀	0.006154 $L^{3.1460}$	0.01020 $L^{3.0080}$	0.01150 $L^{2.9582}$	0.03323 $L^{2.6581}$
Total	0.01116 $L^{2.9606}$	0.01338 $L^{2.9196}$	0.01233 $L^{2.9353}$	0.01891 $L^{2.8102}$
	V	VI	VII	VIII
Total	0.001550 $L^{3.5314}$	0.03485 $L^{2.6018}$	0.003867 $L^{3.2337}$	0.01196 $L^{2.9038}$

Estimated catch per 100 hours fishing 11.9 cwt.

Age Composition.

The determination of age was continued as in 1946 and resultant annual diagrams showing the percentage age composition are given in Figure 3 and Tables 1, 2 and 3 for Rye Bay and the two North Sea areas. In Rye Bay the strongest II-group since the observations began follows the strongest I-group which appeared in 1946. This largely represents the 1945 year-class and it is interesting and important to note that it is also the most numerous year-class in the southern area of the North Sea, although here it is composed of fish the greater part of which are male, whereas in Rye Bay females

predominated. In the more northern of the North Sea areas the II-group is of little account although it was relatively more abundant than the previous year.

The III- and IV-groups (1944 and 1943 year-classes) are well represented in Rye Bay and the North Sea areas. In the latter the IV-group is stronger, and indeed in the northernmost of the areas it is dominant. It would appear from a consideration of the Rye Bay histograms given in Ann. Biol. Vols. II and III, that there have been three strong year-classes in recent years, those of 1943, 1944 and 1945. These strong year-classes

Table 2.

Plaice from Statistical Rectangles G.3, G.4 — H.3, H.4. (All Trawlers).

Composition by numbers and percentage in 1947 with respect to average length, S.(L), average weight, raised numbers, raised weight and catch per 100 hours fishing.

Group		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
fish ned	♂	1	129	74	90	76	96	123	64	32	25	10	10	730
	♀	3	88	43	39	40	33	46	34	11	16	17	18	388
	Total	4	217	117	129	116	129	169	98	43	41	27	28	1,118
%	♂	0.1	17.7	10.1	12.3	10.4	13.2	16.8	8.8	4.4	3.4	1.4	1.4	—
	♀	0.8	22.7	11.1	10.0	10.3	8.5	11.9	8.8	2.8	4.1	4.4	4.6	—
	Total	0.4	19.4	10.5	11.5	10.4	11.5	15.1	8.8	3.8	3.7	2.4	2.5	—
ated No. (00's)	♂	5.8	745.7	444.6	682.8	431.4	570.9	689.4	395.3	215.0	179.4	102.4	52.0	4,514.7
	♀	17.4	510.0	295.7	284.4	346.5	214.1	289.3	343.2	151.7	175.7	263.6	163.5	3,055.1
	Total	23.2	1,255.7	740.3	967.2	777.9	784.9	978.7	738.5	366.6	355.0	366.0	215.5	7,569.5
ated t (cwt) (00's)	♂	0.0	2.0	1.5	3.2	2.5	3.9	5.1	3.2	1.8	1.6	0.9	0.5	26.2
	♀	0.0	1.3	1.1	1.4	2.0	1.5	2.5	3.4	1.5	2.3	3.6	2.7	23.3
	Total	0.1	3.3	2.7	4.6	4.5	5.3	7.5	6.6	3.4	3.9	4.5	3.2	49.6
per 100 fishing	♂	0.0	2.3	1.8	3.7	2.9	4.5	5.9	3.7	2.1	1.9	1.1	0.6	30.5
	♀	0.0	1.6	1.3	1.6	2.3	1.7	2.9	4.0	1.8	2.6	4.1	3.1	27.0
	Total	0.0	3.9	3.1	5.3	5.2	6.2	8.8	7.7	3.9	4.5	5.2	3.7	57.5
ge t (g.)	♂	120	136	175	242	300	362	383	426	439	471	461	—	—
	♀	113	134	190	229	290	352	452	547	625	680	749	—	—
	Total	115	135	181	238	296	360	401	468	486	553	642	—	—
ge (cm.)	♂	22.5	23.6	25.9	28.8	31.2	33.4	34.6	36.0	36.4	37.2	36.8	—	—
	♀	21.8	23.3	26.3	28.4	30.5	32.5	35.7	38.9	40.2	42.4	43.5	—	—
	Total	22.0	23.4	26.1	28.7	30.9	33.2	34.9	37.0	37.4	39.2	41.0	—	—
	♂	—	1.28	2.07	2.76	3.37	4.15	2.99	2.69	2.71	2.30	—	—	—
	♀	—	1.25	2.45	2.78	2.47	3.21	4.22	3.34	5.16	3.97	—	—	—
	Total	—	1.27	2.21	2.76	3.10	3.94	3.39	3.23	3.82	3.98	—	—	—

Comparison between Weight and Length $W = CL^n$.

	II	III	IV	V
♂	0.0132 L ^{2.9264}	0.02089 L ^{2.7734}	0.03752 L ^{2.6039}	0.06787 L ^{2.4285}
♀	0.9110 L ^{1.5861}	0.01368 L ^{2.9136}	0.07729 L ^{2.3793}	0.01884 L ^{2.8186}
Total	0.1371 L ^{2.2020}	0.01848 L ^{2.8184}	0.06863 L ^{2.4190}	0.06425 L ^{2.4466}
	VI	VII	VIII	
♂	0.04966 L ^{2.5268}	0.005097 L ^{3.1683}	0.006275 L ^{3.0994}	
♀	0.08285 L ^{2.3927}	0.006692 L ^{3.1120}	0.03591 L ^{2.6340}	
Total	0.05483 L ^{2.5030}	0.004123 L ^{3.2413}	0.01435 L ^{2.8776}	

larise from parents who had probably grown maturity in greater numbers due to the protection afforded by the war. The 1943 and 1945 classes are particularly strong, but that of 1945 was the younger and its presence as a I-group representing 15 % of the Rye Bay stock in 1946 preceding appearance as the dominant group in the south-east of the North Sea areas in 1947 suggests a strong group in the southern North Sea may

sometimes be forecast from Rye Bay observations. The effect of the strong 1945 and other young classes on the fishery off Lowestoft in late 1947 was to produce large numbers of undersized fish which were an embarrassment to the market. In September, for instance, reports from English trawlers working in the North Sea indicated that upwards of 50 % of the catch was being dumped overboard as being too small to take back to port.

Table 3.
Plaice from Statistical Rectangles F6, F7 — G 6, G 7 — H 6, H 7. (All Trawler)
Age Composition by numbers and percentage in 1947 with respect to average length, S(L)
average weight, raised numbers, raised weight and catch per 100 hours fishing.

Age-Group		II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
No. of fish examined	♂	18	147	448	394	321	178	111	64	22	14	6	1,723
	♀	17	151	365	305	277	156	181	152	102	69	117	1,819
	Total	35	298	813	699	598	334	292	216	124	83	123	3,615
%	♂	1.1	8.5	26.0	22.9	18.6	10.3	6.4	3.7	1.3	0.8	0.4	—
	♀	0.9	8.0	19.3	16.1	14.6	8.2	9.6	8.0	5.4	3.7	6.2	—
	Total	1.0	8.3	22.5	19.3	16.5	9.2	8.1	6.0	3.4	2.3	3.4	—
Estimated No. (in 1000's) of fish landed	♂	83.5	712.7	2,275.5	1,979.8	1,617.8	895.7	554.2	314.9	107.5	70.5	29.7	8,641.8
	♀	79.2	751.9	1,888.1	1,546.8	1,393.9	758.3	884.7	733.6	489.7	321.1	553.1	9,400.4
	Total	162.7	1,464.6	4,163.6	3,526.6	3,011.7	1,654.1	1,438.8	1,048.5	597.2	391.7	582.7	18,042.2
Estimated weight (cwt.) (in 1000's)	♂	0.3	3.0	11.5	11.8	10.7	7.1	5.0	3.2	1.0	0.6	0.3	54.5
	♀	0.3	3.4	10.4	10.1	11.2	7.9	12.4	12.1	8.8	6.7	13.4	96.7
	Total	0.6	6.4	22.0	21.8	21.9	15.1	17.4	15.3	9.8	7.4	13.7	151.4
Catch per 100 hours fishing (cwt.)	♂	0.1	1.3	4.9	5.0	4.5	3.0	2.1	1.4	0.4	0.3	0.1	23.1
	♀	0.1	1.4	4.4	4.3	4.7	3.4	5.3	5.1	3.7	2.8	5.7	40.9
	Total	0.2	2.7	9.3	9.3	9.2	6.4	7.4	6.5	4.1	3.1	5.8	64.0
Average weight (g.)	♂	177	214	258	303	339	408	465	527	503	472	—	—
	♀	177	232	282	333	413	547	732	854	934	1,076	—	—
	Total	177	223	269	316	374	473	631	757	858	974	—	—
Average length (cm.)	♂	25.7	27.9	29.6	31.3	32.7	35.1	36.7	38.4	38.0	37.4	—	—
	♀	25.9	28.4	30.4	32.1	34.3	37.9	41.6	43.6	45.0	47.5	—	—
	Total	25.8	28.2	30.0	31.7	33.5	36.4	39.8	42.0	43.8	45.8	—	—
S. (L.)	♂	3.31	2.82	3.36	3.55	3.83	3.43	3.36	3.21	2.84	—	—	—
	♀	2.78	3.18	3.38	4.02	4.86	5.61	4.74	4.37	5.20	—	—	—
	Total	3.02	3.01	3.39	3.78	4.41	4.78	4.89	4.69	5.55	6.34	—	—

Comparison between Weight and Length $W = CL^n$.

	II	III	IV	V	VI
♂	0.008175 L ^{3.0572}	0.01018 L ^{2.9825}	0.01035 L ^{2.9760}	0.02771 L ^{2.6936}	0.01275 L ^{2.9123}
♀	0.005212 L ^{3.1907}	0.01762 L ^{2.8301}	0.01445 L ^{2.8872}	0.03052 L ^{2.6689}	0.01214 L ^{2.9391}
Total	0.008072 L ^{3.0569}	0.01724 L ^{2.8320}	0.009645 L ^{2.9992}	0.03948 L ^{2.5952}	0.01145 L ^{2.9511}
	VII	VIII	IX	X	XI
♂	0.01389 L ^{2.8927}	0.007449 L ^{3.0559}	0.004544 L ^{3.1902}	0.002849 L ^{3.3053}	0.01628 L ^{2.8340}
♀	0.01056 L ^{2.9728}	0.003582 L ^{3.2677}	0.001655 L ^{3.4737}	0.007015 L ^{3.0894}	0.004078 L ^{3.2265}
Total	0.01071 L ^{2.9697}	0.003444 L ^{3.2777}	0.001963 L ^{3.4282}	0.004047 L ^{3.2298}	0.003465 L ^{3.2664}

Average Length of Age-Groups.

In the Rye Bay area the average length from IV-group upwards was less in 1947 than in 1946 (Figure 4, Table 1) and tended to be like the southern North Sea area. Below IV-group the Rye Bay fish had grown faster than those from the North Sea. Of the two North Sea areas growth was better in the north than in the south (Tables 2 and

3). Up to IX-group the lengths of the p from the southern North Sea area were lower in 1946. From this group upwards the 1947 were growing faster. In the northern area from —VII-groups length for age remained much same as in 1946. Thereafter it was clear that older fish were growing faster in 1947, probably a result of thinning out due to extensive fishing. In both the North Sea areas the II-group len

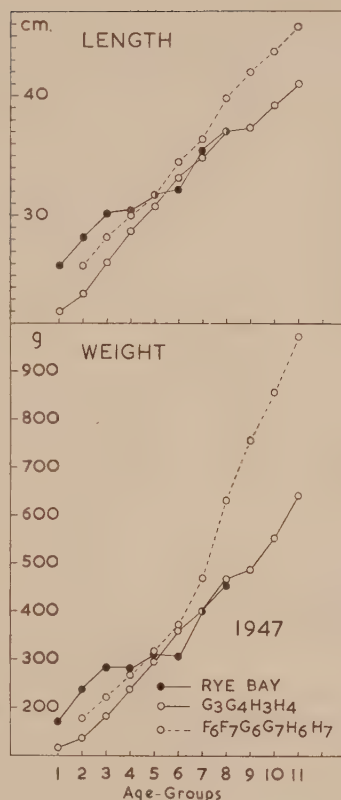
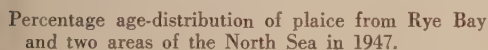


Fig. 4.
Mean lengths and
weights for age-
groups in respect
of plaice from Rye
Bay, statistical
rectangles G₃, G₄,
H₃, H₄, and F₆, F₇,
G₆, G₇, H₆, H₇.

Table 4.

Commercial Landings at Lowestoft and Grimsby 1947. (Steam Trawlers).

Age Composition by numbers and percentage, average length, S. (L.), average weight, raised numbers, raised weight, and catch per 100 hours fishing.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
fish ned	18	1,088	1,416	2,585	1,576	1,258	734	591	410	267	189	240	10,372
	0.2	10.5	13.7	24.9	15.2	12.1	7.1	5.7	4.0	2.6	1.8	2.2	—
ated No. (000's)	73.4	4,616.1	7,432.8	14,432.9	8,493.9	6,359.4	3,646.6	2,858.8	1,987.8	1,260.0	906.4	1,167.6	53,235.7
n landed													
ated t (cwt.) (000's)	0.2	13.3	30.8	71.7	51.5	45.9	32.5	32.9	27.3	18.9	15.6	24.6	365.2
per rs. g (cwt.)	0.0	2.3	5.4	12.7	9.1	8.1	5.8	5.8	4.8	3.3	2.7	4.3	64.3
ge (5.)	117	144	209	255	315	372	457	599	716	787	898	—	—
ge (cm.)	22.1	24.1	27.2	29.3	31.5	33.4	36.0	39.2	41.4	42.7	44.6	—	—
)	—	1.80	2.92	3.23	3.74	4.32	4.51	4.63	4.63	5.45	6.06	—	—

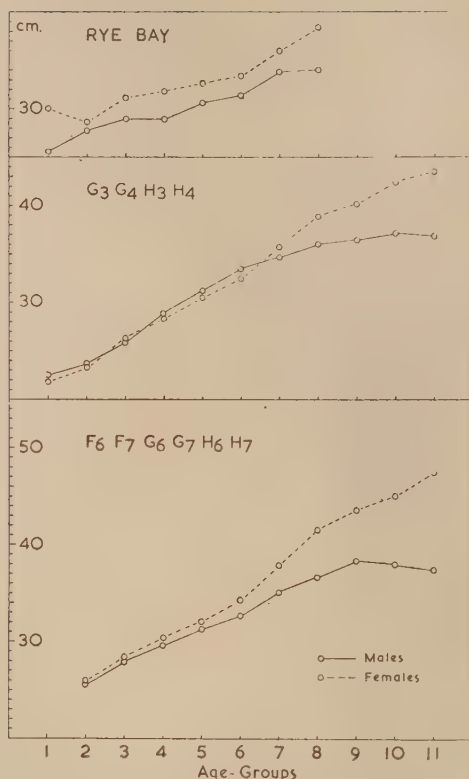


Fig. 5. Mean lengths of male and female plaice at different ages from Rye Bay, statistical rectangles G3, G4, H3, H4, and F6, F7, G6, G7, H6, H7.

area males and females have much the same length until they reach the V-group, after which there is a relative increase in female length. From IX-group onwards male length shows little change in both North Sea areas. In the whole samples females are relatively more important in Rye Bay and least so in the southern North Sea area.

Average Weight.

There was little difference in the average weights of Rye Bay fish compared with 1946, but in the southern area of the North Sea the II- and III-group fish were lighter while the older ones were heavier than in 1946 (Figure 4, Table 2). In the northern area of the North Sea the II-group fish were also lighter than the year before, but all the other year-groups except VI were heavier. From this it would appear that conditions had suffered little change in the Rye Bay district, but in the North Sea area there may have been some overcrowding or lack of food among the II-group recruits, whilst the growth of most of the older fish had increased, either as a result of the thinning out of the population by fishing, or by better food supplies.

Table 5.

Landings of Plaice at Hastings in cwt., (percent in brackets) and below (a) Plaice (b) all Demersal Fish, at Rye Bay Ports.

1947.

	Large	Medium	Small
January	50 (14)	211 (59)	95
February	66 (13)	312 (61)	136
March	66 (12)	318 (60)	149
April	64 (11)	332 (60)	160
May	47 (12)	241 (59)	118
June	21 (12)	107 (59)	53
July	24 (12)	118 (58)	60
August	32 (12)	162 (58)	84
September	14 (12)	68 (58)	36
October	35 (11)	184 (59)	94
November	20 (13)	91 (58)	45
December	20 (13)	88 (59)	41
Total	459	2,232	1,071

(a) 8,438.

(b) 11,345.

Fishing Effort.

Judged by the number of trawlers working Grimsby and Lowestoft and employing the method used to produce similar estimates for last year (Ann. Biol. III, p. 71) we may say that 2,400 trawlers caught 53.2 million plaice weighing 365,210 cwt. (Table 4) and giving a catch per 100 hours fishing of 64 cwt. or 152 cwt. per man. This compares with 88 and 210 cwt. in 1946. In Rye Bay, where the number of fishing trips continued to fall (Table 6), 110 men caught 1.5 million plaice weighing 8,488 cwt. at a rate of 11.9 cwt. per 100 hours absence from port, or approximately 77 cwt. per man. For last year the catch per 100 hours absence from port was wrongly given as 21.3 cwt. — a figure which represented the total demersal fish. It should have been 16.3 cwt. for plaice — a value still substantially higher than in 1947.

The catch per 100 hours fishing at Grimsby and Lowestoft, or per 100 hours absence from port in the case of the Rye Bay vessels, has, therefore, dropped in 1947 to 72 and 73 % of what it was in 1946.

Table 6.

No. of Fishing Trips made by Motor Trawlers working from Rye Bay Fishing Stations (Hastings, Rye, Dungeness).

Months	I	II	III	IV	V
1947	164	267	339	600	679
Months	VII	VIII	IX	X	XI
1947	512	555	526	482	156

Commercial Landings.

The total landings at Lowestoft and Grimsby peaked in 1947 by over 90,000 cwt. compared with 1936 and have only to suffer a further similar reduction to approach the 1938 figure.

The Rye Bay landings have continued to fall (Table 5 here and Table 13, p. 72, Vol. III), but are still well above the 1940 figure and about twice the average pre-war landings (Table 5, p. 73, Vol. II).

The categories "large" and "small" fish distinguished in the Hastings landings showed a small increase in the proportion "small" and a small decrease in the "large" which is in conformity with the increase of younger fish shown in the age-analysis.

Literature.

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The Fishing Intensity on the Plaice Stock of the Southern North Sea.

By

S. J. Holt.

THE survival rates and mortality coefficients for the North Sea plaice have been determined from the measurements of the age-composition and catch of each age-group per 100 hrs. fishing by British first-class steam trawlers, as given in the samples taken of the plaice landings at Grimsby and Lowestoft for the years 1936, 1937, 1938, 1939, 1946 and 1947. The percentage survival rates are shown in Table 1, and it will be seen that the post-war rate shows a decrease of about $\frac{1}{3}$ on the pre-war figure.

Table 1.

The Ratio of the catch of successive age-groups of the same brood, for 100 hrs by 1st-class British Steam Trawlers, expressed as a percentage survival rate.

Age	VI	VII	VIII	IX	X	Mean
	V	VI	VII	VIII	IX	
1936/37	33	37	40	49	80	48
1937/38	43	44	56	43	45	46
1938/39	29	40	55	39	51	43
1946/47	72	29	18	21	17	31
Mean	44	38	42	38	48	—

The mean total Instantaneous Mortality coefficient is given by the equation

$$N_{x+1} = N_x e^{-(F+M)}$$

where N_x = catch per 100 hrs. of the Xth age-group during a year.

N_{x+1} = catch per 100 hrs. of the X+1th group during the following year

$F+M$ = Total mortality coefficient; where F represents the mortality due to fishing, and M that due to other causes.

It has been found to be 0.88 in each of the three years 1936/37, 1937/38 and 1938/39, and 1.30 for 1946/47. These figures are significantly different, and if it is assumed that the natural mortalities for pre- and post-war years are not appreciably different, and of the order 0.1 to 0.2, then the fishing intensity on the areas fished principally by British Trawlers was in 1946/47 half as great again as before the war.

It is evident that the southern North Sea plaice is now heavily overfished, and the population will attain a new density level at least as low as that immediately before the war within a short time.

The English Steam Trawler Fishery for Soles in 1947.

By

R. S. Wimpenny.

THE increase in density by weight shown by the English North Sea trawl fishery when 1946 was compared with conditions at the outbreak of war, has been discussed elsewhere by Margetts (1.) who points out that the increase was greater than for any of the other common trawl fish which he investigated and that the proportion of soles to other demersal fish rose by 5 0/0. He noticed however, that there was a gradual decline in the ratio of the density of soles in 1946 compared with 1938 in respect of the Smith's Knoll ground.

Commercial Landings.

The fishing grounds worked by the English steam trawlers in 1946 and 1947 are given in Figure 1, where the catch per hundred hours fishing is contoured for 0—10 cwt. (wide-spaced lines) over 10 and up to 20 cwt. (close-spaced lines) and over 20 cwt. (black).

It will be seen that the areas covered are widely different in the two years, but that there has been a substantial decrease in the weight landed per hundred hours fishing. For the whole area

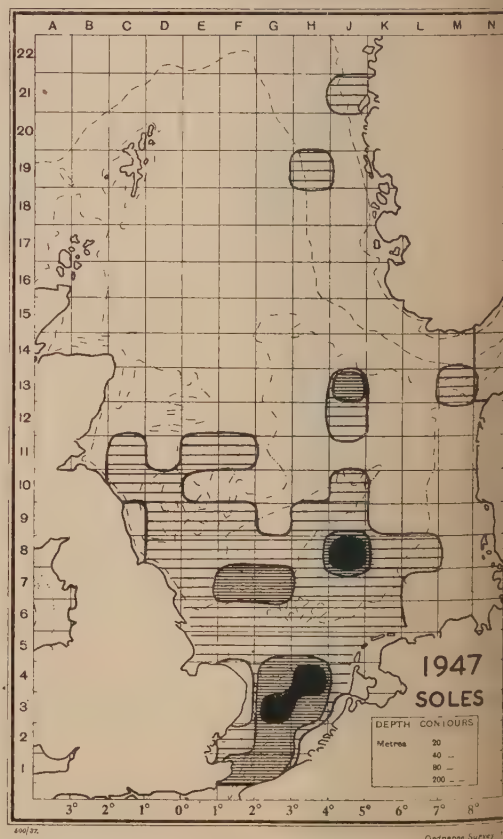
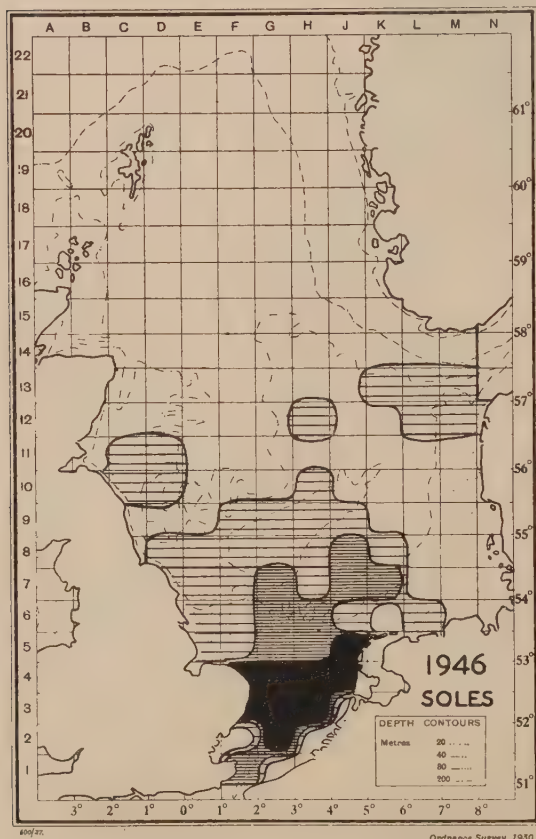


Fig. 1. The catch of soles per 100 hours fishing for 1st class English Steam Trawlers in the North Sea in 1946 (a) and for English and Scottish Steam Trawlers in 1947 (b). Areas in which the catch was up to 10 cwt. are shown by wide-spaced lines, over 10 and up to 20 cwt. by close-spaced lines and over 20 cwt. per hundred hours by black.

Table 1. Landings of Soles from Rectangles D, E, F, G, H, J, 7, 8. —
E, F, G, H, 5, 6. — G, H, 3, 4. — G, 2, F, 1, and Catch per 100 hrs. fishing.

Month	Landings (cwt.)	1946		Landings (cwt.)	1947	
		Total Hours Fishing	Catch per 100 hrs. (cwt.)		Total Hours Fishing	Catch per 100 hrs. (cwt.)
January	17,264	39,317	43.9	11,219	35,171	31.9
February	11,261	35,177	32.0	10,311	32,445	31.8
March	8,090	53,916	15.0	8,492	49,642	17.1
April	4,831	57,123	8.5	5,821	45,515	12.8
May	4,511	56,725	8.0	4,384	46,196	9.5
June	2,350	30,293	7.8	1,038	48,559	2.1
July	4,204	68,459	6.1	1,634	54,501	3.0
August	2,896	50,608	5.7	946	39,755	2.4
September	3,254	31,184	10.4	1,226	44,879	2.7
October	3,399	41,001	8.3	1,572	52,765	3.0
November	4,099	37,776	10.9	1,840	44,340	4.1
December	5,872	30,030	19.6	3,733	46,590	8.0
Year Total	72,031	531,609	13.5	52,216	540,358	9.7

fishery, the density has been more than halved
the landings have considerably decreased.
The following list gives the catch per 100 hours
fishing and the total landing in cwt. compared
previous years.

	Catch in cwt. per 100 hours fishing	Total weight (cwt.)
1932	1	29,331
1933	2	50,803
1934	2	56,168
1935	2	47,570
1936	2	51,350
1937	2	43,515
1938	1	28,998
1946	11	74,020
1947	5	55,934

When we examine the catch per 100 hours fish-
ing the hours fished and the total landings from
the area used by Margetts for his comparison
in pre-war conditions (Table 1) we find that
the catch per 100 hours fishing has fallen from
15 to 9.7 cwt. — much less steeply than for the
whole area. The total landings have, however,
dropped sharply although the total hours fishing has
slightly increased.

Table 1 also shows very clearly that the catch
has dropped through the months of 1946 and 1947,
in spite of the seasonal fall in the summer of each
year.

Length of Fish landed at Lowestoft.

The measurements of soles landed at Lowest-
oft are shown in Figure 2 and Table 2 for each
quarter of the years 1946 and 1947. A considera-
tion of the figure shows that the longer fish are
landed in the quarters between April and Septem-
ber at the time when, as we have already seen,
there is a seasonal fall in the density.

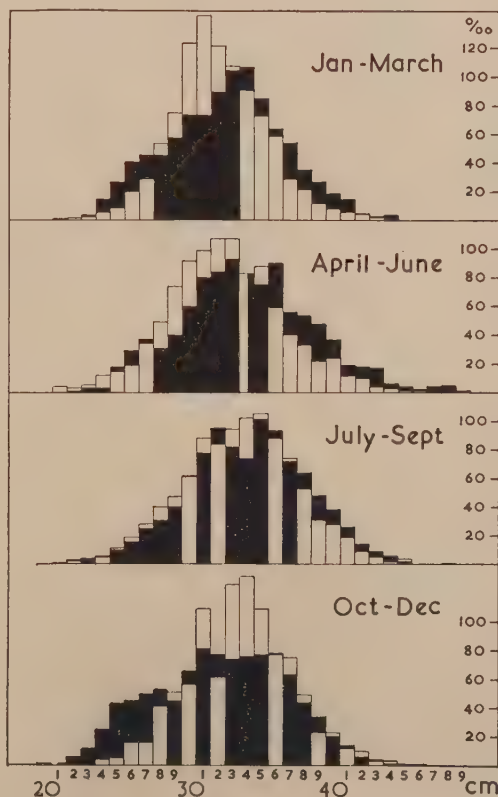


Fig. 2. Frequency histogram per 1,000 fish
showing the length distribution of soles
landed by steam trawlers from the North
Sea each quarter in 1946 and 1947. 1946 is
shown in white, 1947 in black.

Table 2.

Sole Length Frequencies as numbers sampled and Distribution as numbers per mille, in each quarter of 1946 and 1947, from the Lowestoft landings.

cm.	1946								1947							
	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	No. meas'd	Distrib. 0/00	No. meas'd	Distrib. 0/00	No. meas'd	Distrib. 0/00	No. meas'd	Distrib. 0/00	No. meas'd	Distrib. 0/00	No. meas'd	Distrib. 0/00	No. meas'd	Distrib. 0/00	No. meas'd	Distrib. 0/00
19	—	—	—	—	—	—	—	—	1	0	—	—	—	—	—	—
20	1	0	—	—	—	—	—	—	—	—	—	—	—	—	2	1
21	2	1	8	4	1	0	—	—	1	0	—	—	3	1	2	1
22	4	1	6	3	5	2	—	—	5	2	2	1	7	3	12	6
23	6	2	10	5	12	4	—	—	9	4	4	3	7	3	24	12
24	19	6	24	12	14	5	3	4	32	15	4	3	15	6	48	25
25	27	9	30	15	29	11	4	5	60	27	26	18	24	10	83	43
26	63	20	38	19	52	19	12	16	91	41	41	29	39	16	87	45
27	92	29	69	34	78	28	12	16	102	46	52	37	62	25	97	50
28	170	54	100	49	110	40	30	41	102	46	44	31	77	31	103	53
29	234	75	151	74	129	47	37	51	128	58	57	40	99	40	88	45
30	389	124	186	92	168	61	41	56	165	74	85	60	153	62	128	66
31	449	143	201	99	241	88	80	109	164	74	115	81	189	77	158	81
32	383	122	216	107	229	84	45	62	199	90	120	85	233	95	150	77
33	338	108	217	107	258	94	92	126	233	105	131	93	202	82	144	74
34	286	91	168	83	279	102	96	131	238	107	117	83	183	74	148	76
35	227	73	179	88	287	105	79	108	189	85	106	75	248	101	149	77
36	185	59	119	59	240	88	56	77	142	64	127	90	229	93	152	78
37	90	29	82	40	202	74	55	75	119	54	79	56	178	72	125	64
38	68	22	66	33	145	53	36	49	78	35	77	54	157	64	85	44
39	36	12	45	22	85	31	17	23	59	27	68	48	115	47	65	34
40	26	8	48	24	77	28	17	23	42	19	52	37	94	38	38	20
41	19	6	24	12	51	19	9	12	32	15	27	19	63	26	27	14
42	11	4	20	10	24	9	7	10	11	5	25	18	35	14	12	6
43	7	2	9	4	14	5	2	3	6	3	24	17	21	9	7	4
44	1	0	6	3	6	2	2	3	8	4	8	6	15	6	4	2
45	1	0	2	1	4	1	—	—	1	0	6	4	9	4	2	1
46	—	—	2	1	1	0	—	—	—	—	3	2	1	0	2	1
47	—	—	1	0	1	0	—	—	1	0	5	4	1	0	—	—
48	1	0	—	—	—	—	—	—	—	—	7	5	3	1	—	—
49	—	—	1	0	—	—	—	—	—	—	1	1	—	—	—	—
50	—	—	1	0	—	—	—	—	—	—	—	—	1	0	—	—
Total	3,135		2,029		2,742		732		2,218		1,413		2,463		1,942	

A notable feature of these measurements is the fact that, for the first three quarters of the year, 1947 was characterised by the larger proportion of fish over 33 cm. and a corresponding reduction in those of smaller size than was the case in 1946. An increase in the growth-rate due to thinning out might be one explanation of this, but, as we have no information on the age—length relation during these two years, this explanation is purely speculative. The changes might equally well be explained by some selective mortality of the smaller fish or

by a small movement of the fishery. In any case it is quite clear that we are in need of much more information on the life history, migrations, composition and growth-rate of this valuable species, as well as extensive data on size selection of soles by different cod-end meshes.

References.

- (1) Margetts, A. R. Report of Special Meeting on the effect of the War on the Demersal Fish of the North Sea. Rapp. et Proc.-Verb., Vol. No. 122, 1948.

Statistiques Biologiques des Concentrations Annuelles de Harengs Guais sur la Côte Belge.

(Matériel prélevé au cours de l'hiver 1946-47).

Par

Ch. Gilis.

Les investigations ont débuté en Décembre 1946 et ont duré jusqu'à la fin de Février 1947, soit jusqu'au moment de la disparition du hareng de notre côte.

Le matériel étudié comporte 29 échantillonnages

de 25 individus chacun, soit 725 harengs au total.

Afin de pouvoir suivre les changements biologiques qui peuvent se présenter dans le temps, nous avons scindé les résultats de nos investigations en trois périodes: Décembre, Janvier et Février.

I. Taille.

Les longueurs ont été mesurées au millimètre).

Première période: Décembre 1946.
Nombre d'individus mesurés: 250 (10 échantillons)
Tailles observées: 20 à 29 cm.
Taille moyenne: 26.36 cm.
Mode: 27 cm.

Deuxième période: Février 1947.
Nombre d'individus mesurés: 225 (9 échantillons)
Tailles observées: 18 à 29 cm.
Taille moyenne: 26.11 cm.
Mode: 27 cm.

Deuxième période: Janvier 1947.
Nombre d'individus mesurés: 250 (10 échantillons)
Tailles observées: 22 à 29 cm.
Taille moyenne: 26.52 cm.
Mode: 27 cm.

Les trois périodes réunies: Décembre 1946 à Février 1947.
Nombre d'individus mesurés: 725 (29 échantillons)
Tailles observées: 18 à 29 cm.
Taille moyenne: 26.34 cm.
Mode: 27 cm.

Répartition pour 100 des tailles observées.

Taille en cm.	18	19	20	21	22	23	24	25	26	27	28	29
1ère période	—	0.4	0.4	1.6	6.4	6.8	4.8	6.4	18.8	34.0	17.6	2.8
2e période	—	—	—	—	4.8	3.2	5.6	10.0	28.8	36.0	10.8	0.8
3e période	0.4	0.4	0.4	—	5.3	8.0	4.9	16.0	21.0	28.0	14.2	1.3
Pour l'ensemble	0.1	0.2	0.2	0.5	5.6	5.9	5.1	10.6	22.9	32.8	14.2	1.7

II. Poids.

Poids observé en gr.

Périodes	Poids minimum	Poids maximum	Poids moyen
1ère	40	145	115
2ème	70	155	116
3ème	40	150	108
Pour l'ensemble	40	155	113

III. Sexe.

Répartition pour 100 des mâles et des femelles.

Périodes	Mâles	Femelles
1ère	48.4	51.6
2ème	51.2	48.8
3ème	40.4	59.6
Pour l'ensemble	46.9	53.1

IV. Stades des gonades.

Répartition pour 100 des stades de maturité (Lowestoft 1930).

Périodes	I	II	VI	VII	VIII-II
1ère	1.2	—	0.4	2.4	96.0
2ème	—	—	0.4	2.0	97.6
3ème	—	0.4	0.4	0.9	98.2
Pour l'ensemble	0.4	0.1	0.4	1.8	97.2

V. Graisse mésentérique.

Répartition pour 100 de la quantité de graisse (signes de Hjort).

Périodes	0	1	+	M
1ère	62.8	33.2	2.8	1.2
2ème	43.6	53.6	2.8	—
3ème	48.0	44.4	7.2	0.4
Pour l'ensemble	51.6	43.7	4.1	0.6

VI. Age.

Répartition pour 100 des différentes classes d'âges observées.

Anneaux d'hiver	1	2	3	4	5	6	7	8	9	10 et plu
Age	2	3	4	5	6	7	8	9	10	11 et plu
Classe de recrutement	1944	1943	1942	1941	1940	1939	1938	1937	1936	Antérieur à 1936
1ère période	1.3	12.5	11.3	3.8	7.9	5.0	16.3	7.1	22.6	12.1
2ème période	—	5.3	10.2	9.4	6.6	3.3	25.0	8.6	19.7	11.9
3ème période	0.9	12.1	15.4	8.8	10.2	1.9	22.3	2.3	17.2	8.8
Pour l'ensemble	0.7	9.9	12.1	7.3	8.1	3.4	21.1	6.3	20.0	11.0

VII. Vertèbres.

a) Répartition pour 100 de chaque nombre de vertèbres et moyenne vertébrale.

Période	54	55	56	57	58	59	60	61	Moyenne vertébrale
1ère	—	2.8	48.4	43.6	5.2	—	—	—	56.51
2ème	0.4	1.6	37.6	52.8	6.8	0.4	—	0.4	56.67
3ème	0.4	3.2	39.1	48.0	9.3	—	—	—	56.63
Les 3	0.3	2.5	41.8	48.2	7.0	0.1	—	0.1	56.60

b) Répartition pour 100 de chaque nombre de vertèbres cervicales ou précaudales.

Période	22	23	24	25	26	27	28	Moyenne
1ère	—	—	—	—	—	—	—	—
2ème	1.1	23.4	49.7	24.0	1.1	—	0.6	24.03
3ème	2.2	28.9	45.8	17.8	4.9	0.4	—	23.95
Les 3	1.7	26.5	47.5	20.5	3.2	0.3	0.3	23.98

VIII. Taille et Age.

a) Longueur moyenne en cm. des harengs de 3 à 7 ans (mensurations au mm.).

Age	Classes de recrutement	1ère	2ème	3ème	Les 3
3	1943	22.85	22.83	22.63	22.78
4	1942	24.75	24.28	24.66	24.57
5	1941	25.52	25.75	25.78	25.72
6	1940	26.41	26.79	26.26	26.50
7	1939	27.26	27.26	27.35	27.27

b) Valeur de L_1 en mm.

Classes de recrutement	1ère	2ème	3ème	Moyenne générale 1946-47	1945-46
1943	117	105	105	109	—
1942	114	107	109	110	108
1941	113	109	110	109	108
1940	108	125	111	117	113
1939	118	126	97	118	124
1938	120	117	114	117	112
1937	120	123	125	120	111
1936	115	110	105	108	109

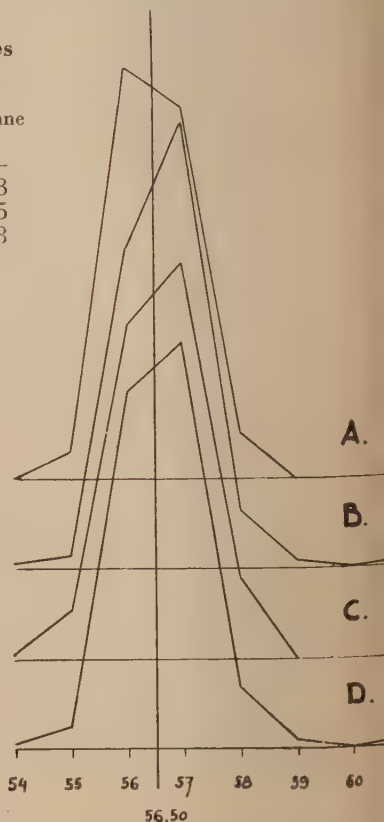


Fig. 2. Polygones des variations du nombre de vertèbres: A. Décembre, B. Janvier, C. Février, D. Saison.

IX. Ecailles en carène.

Répartition pour 100 du nombre d'écailles
en carène (K2).

Période	13	Nombre de K2				17	Moyenne
1ère	—	—	—	—	—	—	—
2ème	5.3	28.7	49.3	16.0	0.7	14.78	
3ème	5.3	29.3	52.0	12.5	0.8	14.74	
Les 3	5.3	27.2	47.6	13.0	0.7	14.76	

X. Contenu stomacal.

Contenu alimentaire observé.

Période	Nombre d'estomacs examinés	Estomacs avec contenu	
1ère	250	1	0.4

Nature du contenu

1 *crangon vulgaris*

Période	Nombre d'estomacs examinés	Estomacs avec contenu	
2ème	250	6	2.6

Nature du contenu

- 2 estomacs pleins: Mysidae
- 1 estomac $\frac{1}{4}$ plein: débris de copépodes
- 2 estomacs pleins: débris de copépodes et
oeufs de hareng
- 1 estomac avec 1 *Gobius minutus*

Période	Nombre d'estomacs examinés	Estomacs avec contenu	
3ème	225	74	32.9

Nature du contenu

- 13 estomacs pleins: débris de copépodes
- 21 estomacs $\frac{1}{2}$ pleins: débris de copépodes
- 34 estomacs $\frac{1}{4}$ pleins: débris de copépodes
- 2 estomacs $\frac{1}{2}$ pleins: débris de copépodes et
larves de poissons
- 1 estomac $\frac{1}{2}$ plein: Schizopodes
- 2 estomacs pleins: larves de poissons
- 1 estomac plein: oeufs de hareng

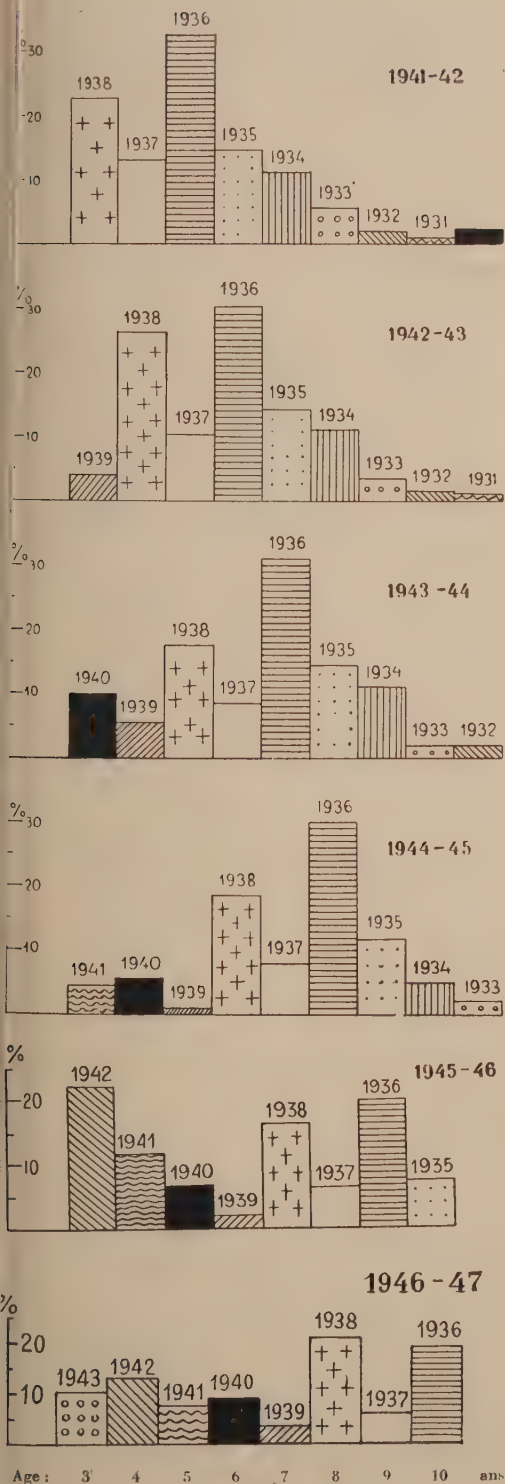


Fig. 1. Escalier biologique des Harengs Guais.

The East Anglian Herring Fishery in 1947.

By

William C. Hodgson,
Fisheries Laboratory, Lowestoft.

IN July 1947 a herring fishery forecast was issued for the first time since 1939. In the forecast it was stated that the prospects for the fishery were that two good groups of herrings, aged four and five years, were expected, and that since the herrings reach their maximum abundance in the shoals at these ages, large concentrations could be expected.

The fish older than seven years of age would together constitute a fair-sized proportion of the total stock, but coming as they do near the end of the season, it was not expected that they would have the same influence on the landings as the younger fish. It is well known that the date of the full moon has an important bearing on the character of the East Anglian fishery, and since the October full moon occurred on the 29th of the month it was known that this season would have only one period of heavy catches, and that period

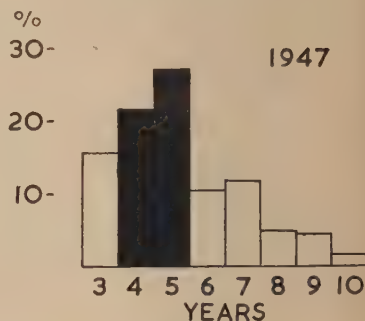


Fig. 2.

could be expected between October 26th and November 1st. The forecast also showed that this period of heavy catches there should gradual decline in the size of the landings only a small chance of recovery at the time of November full moon at the end of that month.

Figure 1 shows the history of the fishery by week, and, since the histograms represent average number of herrings of each age landed by each vessel per week, the fluctuations in fishery can be easily followed.

It is characteristic of all East Anglian seasons in which there is a late October full moon that the fishery is somewhat late in starting, and the 1947 season was no exception. The scarcity of fish on the local grounds made it necessary for drifters to work much further to the north than they would normally do, and the first large catch was obtained during the week ending October 18th, typical of the northern fish, for it will be seen that the seven-year-old fish are almost as well represented as the four and five-year-olds.

After the first week, the young herring behaved exactly as one would have expected them to. The three and four-year-old fish reached maximum abundance during the full moon period and then began to decline. The five-year-olds actually increased until the week following the full moon, and, as stated in the forecast, the older fish were never able to cause heavy landings near the end of the season.

The age composition of the whole fishery is shown in Figure 2. The high percentage of young fish promises well for the 1948 season when we can expect a very pronounced four-year-old group as well as good five and six-year-old groups.

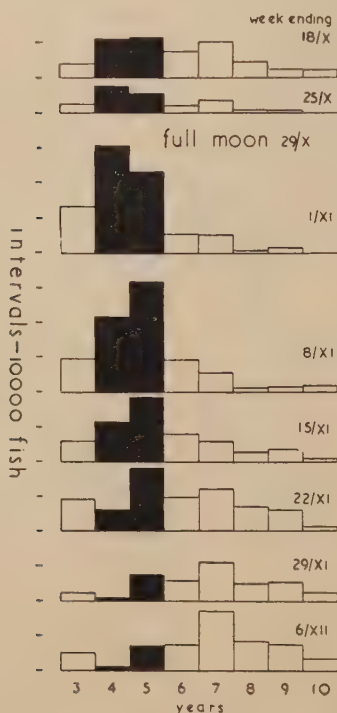


Fig. 1.

is part of the sampling technique to find the weight of the herrings at each age in the fishery, becomes a matter of great simplicity to compare the "condition" of herrings of different seasons for such things as weight and fat-content are of considerable importance to curers, canners and exporters.

Figure 3 shows a comparison, so far as weight is concerned, between the seasons 1946 and 1947.

There is a striking difference between the condition of the herrings in the two years, and it can be seen that, for the ages five to nine, the fish were approximately 1 ounce (28.35 g.) heavier than the fish of corresponding ages in the previous year. For fish like the East Anglian herring, whose weight ranges between 3.5 and 6.5 oz., this is a very considerable increase between one year and another, and is an increase which needs further detailed consideration.

The first step obviously is to make a comparison between the lengths of the fish in the two years, and this has been done in Figure 4.

Starting from the three-year-old fish, the lengths for herrings of similar ages are almost identical, so that the difference in the weight of the

fish cannot be due to their length. It must be due to the weight of the flesh, since the gonad condition was the same in the two years.

In Figure 5, the difference between the two seasons is shown in a different way, by comparing the number of fish per cran during the fishing periods.

In general, since the young fish appear on the grounds before the older ones, the number per cran decreases gradually throughout the season but it is quite usual to find that the fishery begins with the landings of some large herrings. This is because the first catches come from the northern grounds, where the fish cannot be called true East Anglian herrings.

This figure shows clearly that there were fewer fish per cran in 1947 than in 1946.

This phenomenon has been discussed with my colleague Mr. R. S. Wimpenny, and we find that there is evidence that the weight (i.e. condition) of the herrings is linked with the abundance and condition of the Plankton during the summer when the fish are feeding. This we shall deal with at a later date.

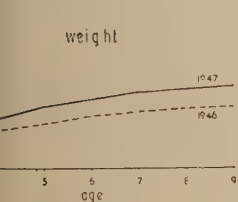


Fig. 3.

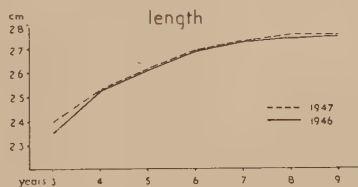


Fig. 4.

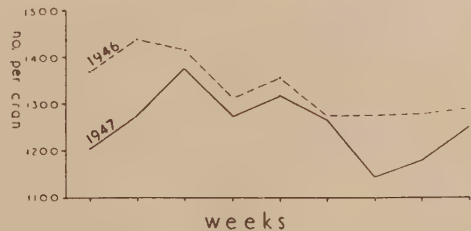


Fig. 5.

Statistiques Biologiques des Populations de Harengs de la Manche Orientale et du Sud de la Mer du Nord (1946—47).

Par

J. Ancellin.

Placements de la pêche.

La pêche du hareng "plein" (stade V de l'adulte), au filet dérivant, a commencé à Boudes la fin d'Octobre 1946, dans la région de Baas; elle s'y est poursuivie jusqu'au début de Décembre.

Le 15 Novembre, par ailleurs, des chalutiers opérant dans le secteur du Sandettié capturèrent de importantes quantités de harengs "guais" (jeuons) en même temps que des morues. Puis, vers la deuxième moitié de Décembre, les chalutiers se portèrent plus au nord, au large de

Nieuport d'abord; dans le secteur du Wandelaar, à une dizaine de milles au NNE. d'Ostende, ensuite. C'est dans ce dernier secteur que le gros de la flottille devait se maintenir jusqu'à la fin de la campagne de pêche qui se produisit assez brusquement vers le 27/28 Février.

La pêche dans la région du sud de la Somme, comme en 1945/46 n'a donné lieu qu'à des tentatives isolées ne paraissant pas avoir abouti à des résultats encourageants.

En résumé le fait dominant de cette campagne est la localisation septentrionale des bancs de

Statistique 1. Taille.

a) Mer du Nord: Groupe Dyck—Sandettié.

Centimètres	15	18	20	21	22	23	24	25	26	27	28	29
Fréquence	1	1	1	3	11	16	29	60	99	87	18	2
Répartition %	0.3	0.3	0.3	0.9	3.3	4.8	8.9	18.3	30.1	26.5	5.4	0.6

N = 328.

Taille moyenne: 25.63 cm.

Taille moyenne rectifiée: 25.63 cm. + 0.50 cm. = 26.13 cm.

b) Manche Orientale: Groupe I Nord—Somme.

Centimètres	22	23	24	25	26	27	28
Fréquence	7	12	30	35	41	20	3
Répartition %	4.7	8.1	20.2	23.6	27.7	13.5	2.0

N = 148

Taille moyenne 25.10 cm.

Taille moyenne rectifiée: 25.10 cm. + 0.50 cm. = 25.60 cm.

N.B. La taille est calculée au centimètre près et ramenée au centimètre inférieur.

harengs "guais" que les pêcheurs avaient l'habitude d'exploiter au cours des années précédentes au large d'une zone côtière comprise entre Gravelines et Blankenbergh.

II) Composition du stock de harengs.

L'examen des classes d'âge (statistique 2) nous montre que la classe 1942 (harengs de 4 ans) est la meilleure (21 % du stock "Dyck—Sandettié" et "Nord — Somme" réunis). Elle ne dépasse toutefois pas le pourcentage moyen des harengs de 4

ans observé au cours des précédentes années de recherche. (26 %).

Les classes 1938 (harengs de 8 ans) et 1940 (harengs de 9 ans) sont encore de très bonnes classes étant donné l'âge des individus. Les classes 1940 et 1939, déficitaires l'année précédente, ont été mieux représentées, sans néanmoins atteindre les moyennes des proportions des harengs de 6 et 7 ans. La classe 1941 reste nettement déficitaire et celle des harengs apparus pour la première fois sur les frayères (1943-harengs de 3 ans) est faible. Dans l'ensemble le stock considéré s'avère plutôt pauvre, en dépit d'une bonne classe, celle des harengs de 4 ans.

III) Statistique biométrique.

a) Moyenne vertébrale. (Statistique 3)

Comme dans les précédentes recherches nous avons distingué le groupe des harengs du "Dyck—Sandettié" aux caractères se rapprochant habituellement de ceux des harengs de la Mer du Nord et le groupe Manche I (Nord de la Somme au Cap Gris-Nez) constituant le terme de passage entre les harengs de la Mer du Nord et ceux de la Manche.

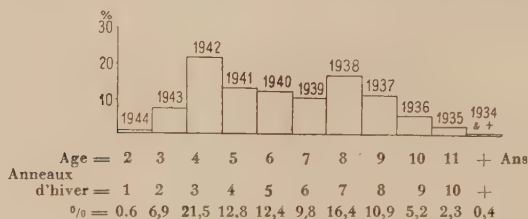


Fig. 1. Composition du Stock de Harengs du Sud de la Mer du Nord et de la Manche Orientale. (Groupes "Dyck-Sandettié" et "Nord-Somme" réunis) 1946/47.

Statistique 2. Age.

a) Mer du Nord: Groupe Dyck—Sandettié.

Anneaux d'hiver	1	2	3	4	5	6	7	8	9	10	+
Age	2	3	4	5	6	7	8	9	10	11	+
Classe	1944	1943	1942	1941	1940	1939	1938	1937	1936	1935	antérieur
Répartition %	0.9	6.4	15.0	10.7	11.6	11.0	20.5	13.4	6.1	3.3	0.6

N = 326

b) Manche Orientale: Groupe I Nord—Somme.

Anneaux d'hiver	2	3	4	5	6	7	8	9
Age	3	4	5	6	7	8	9	10
Classe	1943	1942	1941	1940	1939	1938	1937	1936
Répartition %	8.1	36.0	17.6	13.6	7.4	7.4	6.1	3.4

N = 147

Statistique 3. Moyenne Vertébrale.

a) Mer du Nord: Groupe Dyck-Sandettié.

Nombre de vertèbres	54	55	56	57	58	59
Fréquence	1	6	113	165	21	1
Répartition %	0.3	1.9	36.8	53.7	6.8	0.3

N = 307

Mode = 57

Moyenne = 56.65

Indice de variabilité: ± 0.659

Fluctuation probable

de la moyenne: ± 0.124 b) Manche orientale: Groupe I
Nord-Somme.

	55	56	57	58
	3	50	81	5
	2.1	35.9	58.2	3.3

N = 139

Mode = 57

Moyenne = 56.63

Indice de variabilité: ± 0.594

Fluctuation probable

de la moyenne: ± 0.169

groupe II — Sud de la Somme — n'est pas
ésenté).

La moyenne vertébrale est, pour le groupe I,
56.63 et pour le groupe Dyck-Sandettié 56.65.
Elle a présenté pour le groupe Dyck-Sandettié
variations suivantes au cours de l'hiver:

Décembre : 56.58

Janvier : 56.69

Février : 56.64

L'augmentation de la moyenne vertébrale au
rs des deux premiers mois de l'année 1947
met de supposer qu'une assez forte pénétration
harengs du type "Manche" (moyenne caractéri-

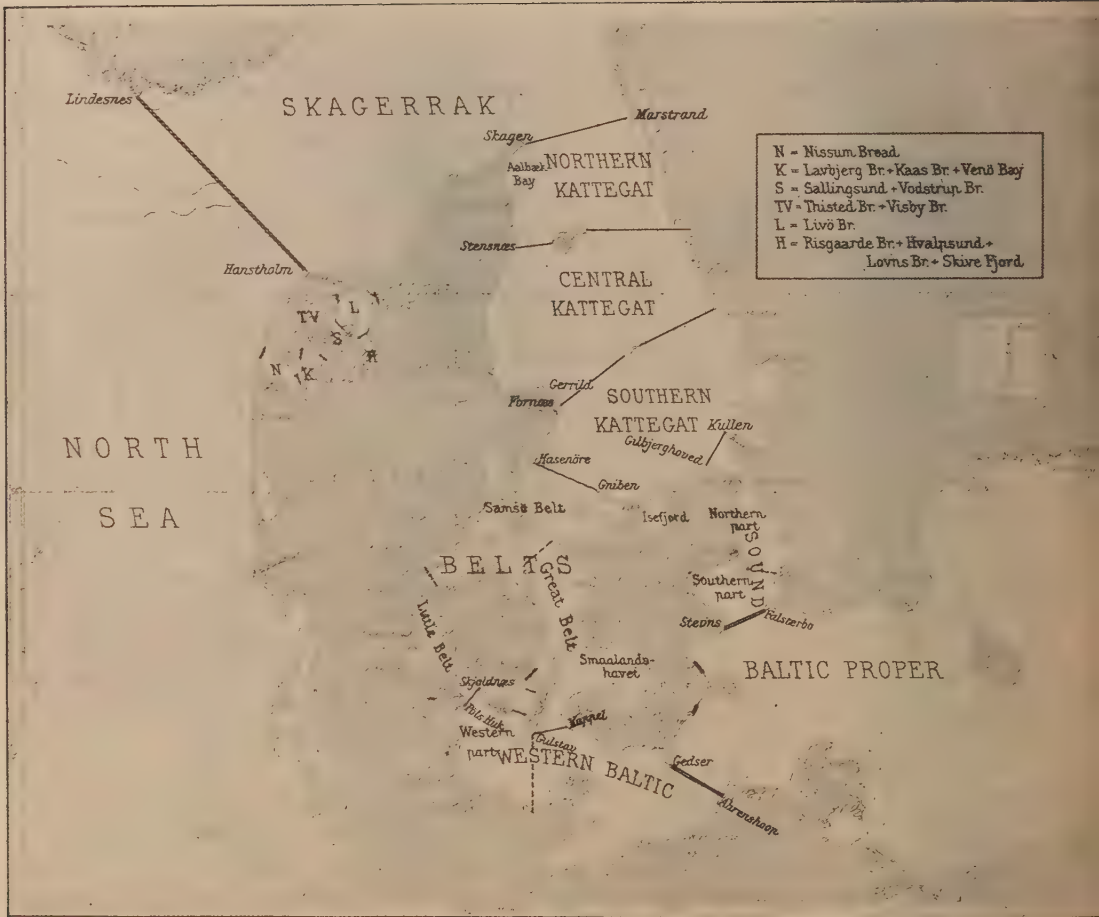
stique 56.70) s'est effectuée dans le Sud de la
Mer du Nord. Ceci ne constitue que l'accentua-
tion d'un phénomène déjà constaté l'année pré-
cédente.

Les polygones de variation du nombre des ver-
tèbres affectent pour chacun des groupes à peu
près la même allure.

b) Ecailles en carène —

L'étude des écailles en carène (écailles post-
ventrales) a fourni les moyennes suivantes:

Groupe "Dyck-Sandettié"	: 14.87 (223 individus)
Groupe "Nord-Somme"	: 14.91 (67 individus)



Map of the Danish Waters showing Limits between the Different Areas.

Transition Area.

INTRODUCTION.

Contributions have been received from Denmark (Aage J. C. Jensen, J. B. Kirkegaard, J. Knudsen and H. Thomsen), Norway (Alf Dannevig) and Sweden (Arvid R. Molander).

A. Environment.

Hydrography. The surface temperatures were very low in 1947 until April and May, but later on they were very much above the normal, reflecting abnormal air temperatures of this year. The monthly means of the residual currents at Halskov in the Great Belt show that during November and December 1946 and June and July 1947 there has been no outflow from the Baltic. When we consider the monthly mean for September 1947 there was a strong inflow and, corresponding to this, the surface salinity at Halskov Rev was high. The surface salinity at Anholt Knob was extraordinarily high in April 1947, indicating a strong inflow through the Kattegat also in this month.

Benthic Food. Valuations of the sea bottom in the Limfjord show that the amount of first-class food and, to a certain extent, also of second-class fish food, was considerably below the average, and Knudsen states that this must have been caused by the severe winter of 1946/47.

The enormous increase in the amount of *Mytilus* taking place at the same time as the development of a fishery for this mussel, according to Knudsen, is possibly due to the fact that shells have been spread over the bottom by the fishery, forming a suitable substratum for the settling of larvae.

B. Fish.

Gadoids. Dannevig states that the numbers of 0-group cod and pollack in the Skagerak in 1947 were very low, while that of whiting was higher than normal.

Plaice. The number of 0-group plaice at the Danish coasts and the southern Kattegat coast of Sweden was very low, corresponding to the low temperatures of the winter 1946/47, but Molander has found a normal amount of 0-group plaice in the central Kattegat, and more than normal at the Swedish Skagerak coast. This may be due to the extraordinarily strong inflow in the surface layer of the Kattegat in April as indicated by the high salinity.

The average length of the plaice caught in the Kattegat in 1947 was still considerably greater than in pre-war years, but the beneficial effect on the fishery in the areas closed during the war was decreasing. In the Belt Sea the length of plaice caught increased because the catches, as in 1946, consisted mostly of the 1944 year-class.

The transplantations of plaice to the Belt Sea and the central Limfjord from the Nissum Broad were carried out on the same scale as in previous years. The length was 17—25 cm. and they were from the 1943 and 1944 year-classes. Kirkegaard states that until November 1947 the growth was about 8 cm., which is about 2 cm. less than normal. The plaice transplanted to the Belt Sea amounted to only 2 to 3 per cent. of the plaice caught in the area, due to the good native stock of the 1944 year-class.

Flounder and Turbot. The number of the 0-group of flounder was below the mean, that of turbot was on the whole about average, or a little higher.

The frequency of the **flat-fish** has been investigated by experimental hauls in the Limfjord and the Isefjord. **K n u d s e n** states that the density of the flounder was 6 times greater in the Isefjord than in the Limfjord, and the length of the age-groups was also greater.

Herring. The herring caught in the trawl at the Skaw during the season of 1946/47 were of about the same size as those caught in the 1945/46 season. However, racial investigations showed that only the large spent and recovering herring, and a small part of the immature herring were unmixed autumn spawners from the western North Sea, while the main part of the young immature herring, which were as usual mostly 1-ringed, was different from these and seems to be Shetland herring or autumn spawners from north-west Scotland mixed with spring spawners.

The stock of herring in the southern Kattegat and the Belt Sea consisted mostly of spring spawners, as has been the case during recent years. Corresponding to this fact the yield of the autumn herring fishery here was poor as in previous years.

In the Limfjord the autumn spawners of the

western North Sea were again represented (mixed with Limfjord spring spawners), while they were absent from the catches investigated during the 1945/46 season.

Eel. The stock in the Limfjord was smaller than in the preceding years. The decline must be ascribed to the severe winter.

Fish for processing caught at the Skaw consisted mostly of whiting, while the rest was mostly sprat, herring and sprat.

Lobster, Norway Lobster and Deep Sea Prawn. **D a n n e v i g** states that the catch of lobster fishing unit decreased a little at the Norwegian Skagerak coast, but this may have been caused by natural fluctuations in the stock.

The Norway lobster fished north and north-west of the Skaw, according to **K n u d s e n**, showed a marked difference from those fished during 1910 to 1939 when fishing was carried out mostly in the northern Kattegat. The males were now larger while the females were smaller and very few of them carried eggs.

The Danish deep sea prawn fishery took about equal numbers of males and females.

Oyster. The oysters along the Norwegian Skagerak coast survived the cold winter very well, as stated by **D a n n e v i g**, but the collecting of oysters spat gave poor results, despite the warm summer.

Aage J. C. Jensen

ENVIRONMENT.

Hydrography.

Norway Coast of Skagerak.

the sea-temperature at Flødevigen near Aren-
metre below the surface, was very low during
first four months of the year. Later it was

relatively high, especially in August and September.
This corresponds with the continental type of clim-
ate occurring that year.

ge:	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
—45	3.04	1.96	2.24	4.53	9.00	12.91	16.19	16.52	14.45	11.22	7.69	5.09
	3.4	2.8	1.4	5.0	10.8	12.9	16.8	16.6	15.3	11.3	7.8	5.2
	1.3	—0.2	—0.1	3.7	11.3	14.2	17.0	19.7	16.7	12.9	8.3	5.9

Alf Dannevig.

Kattegat and Belts.

Table 1. Monthly Means of Salinity at Surface and Bottom at the Lightvessels
"Anholt Knob" (A), and "Halsskov Rev" (H), for a series of years, and Deviations
from these Means.

(From the Danish Meteorological Institute, Nautical Dept.)

Surface.												
vessel	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX
Mean	20.7	21.9	22.8	23.5	23.1	20.2	19.2	18.1	18.9	19.4	20.1	20.7
"	16.2	16.3	15.6	16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6
1946	—1.7 ¹⁾	—1.6	—0.6 ²⁾	1947	—1.5 ³⁾	—	6.5 ⁴⁾	—1.4	—0.9	0.6	—1.3	—0.1
"	—1.2	—1.3	—	"	—	—	—	—1.5	0.0	—0.1	—1.3	2.1
Bottom.												
Mean	32.2	32.4	32.1	31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8
"	23.3	21.5	22.1	21.9	21.7	24.5	27.6	29.7	30.3	29.4	27.6	24.7
1946	0.9 ¹⁾	1.5	1.5 ²⁾	1947	1.6 ³⁾	—	1.1 ⁴⁾	0.5	1.3	1.3	1.6	1.1
"	—5.8	3.2	—	"	—	—	—	—5.5	—1.0	1.3	1.6	3.9

Table 2. Monthly Means of Temperature at Surface and Bottom at the Lightvessels
"Anholt Knob" (A) and "Halsskov Rev" (H), and Deviations from these Means.

(From the Danish Meteorological Institute, Nautical Dept.)

Surface.												
vessel	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX
Mean	10.9	7.1	4.1	2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5
"	11.1	7.3	4.0	2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5
1946	—0.5 ¹⁾	—0.1	0.3 ²⁾	1947	—1.3 ³⁾	—	—0.7 ⁴⁾	0.6	—	—	3.1	—
"	0.0	—0.4	—	"	—	—	—	—1.0	2.4	1.7	2.3	2.5
Bottom.												
Mean	12.1	10.2	8.1	6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1
"	11.6	8.4	5.9	3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2
1946	1.4 ¹⁾	0.3	0.4 ²⁾	1947	1.0 ³⁾	—	1.5 ⁴⁾	0.0	—	—	—4.0	—
"	0.3	1.3	—	"	—	—	—	0.2	0.1	—0.3	—0.4	0.2

) Means of the last 25 days of the month; observations from 1.—6. failing.

) Means of 24 days; observations from 15.—21. failing.

) Means of 20 days; observations from 12.—18. failing.

) Means of the last 21 days of the month; observations from 1.—9. failing.

Table 3. Monthly Means of Residual Surface Currents in cm./sec. at the Lightvessel "Halsskov Rev".

The Current from the Baltic is stated as positive, towards the Baltic as negative.

	X	XI	XII		I	II	III	IV	V	VI	VII	VIII	IX
1946	18.2	—4.2	—0.5	1947	—	—	—	—	33.2	—3.4	3.4	32.3	—37.8

Helge Thomsen.

Benthic Food.

Valuations of the sea bottom with the Petersen grab (1/10 m.²) were carried out in June, July—August and September 1947 in the western and central parts of the Limfjord. In order to make the valuations comparable to those of previous years, when valuations were undertaken in June and September, only the valuations in June and September have been considered in the following.

The table shows the weight in grams of bottom invertebrates per 1 m.² in the two greatest broads (Nissum Br. and Livø Br.). In each of the broads 20 samples were obtained for each of the valuations. The animals were divided into 3 groups: I. first-class plaice food (Vermes, small crustaceans, tectibranchs, *Acera*, *Philine*, bivalves, excluding *Corbula*, *Nucula* and all specimens larger than 3 cm.). II. second-class plaice food (*Nucula*, *Corbula*, small snails and echinoderms). III. non-food (Larger molluscs and echinoderms, ascidians and actinians).

	Nissum Broad			Livø Broad		
	1st-Class	2nd-Class	Non-Food	1st-Class	2nd-Class	Non-Food
June	4.3	7.8	600	3.8	19	90
Sept.	5.6	41	485	23	39	850
Yearly Mean	5.0	25	542	13	29	449
1926/46	9.4	113	91	21	23	255

It appears that the amount of first-class fish food is considerably below the average value and

the same is the case with the amount of second-class fish food in Nissum Broad. This decrease was, no doubt, caused by the extremely severe winter of 1946/47; a corresponding decrease was noticed after the 3 succeeding severe winters 1941 to 1942. During the intermediate period an increase in the amount of fish food took place.

A considerable increase in the non-food group was noted in both broads. The majority of this group consists of *Mytilus*, the number of which has increased very much since 1940, in spite of several severe winters and enormously increased catches. The increase is clearly seen from the figures giving the weight of *Mytilus* in gr./m.² obtained during the valuations:

	1927	1933	1937	1940	1943	1946
	-32	-36	-39	-42	-46	-
Nissum Broad	0	1.0	0	0	60	5
Livø Broad	187	118	34	79	474	4

It appears that in Nissum Broad *Mytilus* was almost absent in the years previous to 1942, during the years 1943 to 1946 their number increased somewhat and in 1947 was very high.

There is no evidence of this increase being connected with optimum temperatures during the spawning season. Possibly large amounts of *Mytilus* shells, originating from the fishery, have been thrown out into the sea, thus forming a suitable substratum for the metamorphosing larvae.

Jørgen Knudsen.

idae.

THE FISH.

young. The ordinary experimental fishing in littoral region in September and October gave following average numbers per haul.

	Cod 0-Gr.	Cod I-Gr. ¹⁾	Whiting 0-Gr.	Pollack 0-Gr.
Skagerak coast				
average 25 years	13.7	1.7	17.8	16.6
1945	13.0	1.0	65.9	32.8
1946	1.8	1.1	20.9	3.6
1947	2.5	0.4	22.6	2.2
Oslofjord				
average 6 years				
1939, 1945/46	37.9	3.5	13.3	5.4
1945	92.0	1.2	34.5	16.0
1946	0.9	9.1	15.3	0.6
1947	2.4	0.5	16.1	0.9

¹⁾ A few older included.

As in 1946, the number of **cod** and **pollack** was low. The number of **whiting** in both years was rather than normal. The results along the coast in the Oslofjord correspond.

The experimental fishing with traps at Fløden resulted in 72 cod per trap. This is quite high, as is also the relative abundance of the different year-classes with the II-group always predominating.

Alf Dannevig.

Flat Fish.

Abundance of Year-Classes.

Danish and Swedish Coasts

The investigations were carried out as usual by a Johansen young-plaice trawl drawn at 2 m. depth by a motorboat.

Table 4.
Number of Plaice of the 0-Group
and I-Group.

	No. of Stations	No. per 30 min. haul 1947		Mean 1927-46	
		0-Gr.	I-Gr.	0-Gr.	I-Gr.
Danish coasts					
Skagerak	18	12	5	23	9
N. Kattegat	20	8	6	41	26
C. Kattegat	20	2	0.6	15	5
S. Kattegat	20	6	2	14	1
Sound	12	6	0	11	1
Belts	89	2	2	14	1
W. Baltic	13	0.5	0.5	7	0.2
	No. of Stats.	1947 ¹⁾		Mean 1929-38	
		0-Gr.	I-Gr.	0-Gr.	I-Gr.
Swedish coasts					
Skagerak	26	171	0.8	50	0.8
C. Kattegat	8	77	2	75	2
S. Kattegat	28	10	2	96	2
Sound	6	3	0	7	0

¹⁾ Owing to an error some wrong figures have been given in Ann. Biol. III for 1946. The correct figures are the following:—

	No. of Stats.	No. per 30 min.	
		0-Gr.	I-Gr.
Skagerak	27	80	5
C. Kattegat	8	15	4
S. Kattegat	22	20	1
Sound	0	—	—

At the Danish coast and at the southern part of the Swedish west coast the number of 0-group plaice was very small corresponding to the low winter temperature of 1947. At the Swedish Skagerak coast the number of plaice, on the other hand, is remarkably high.

Table 5. Number of Flounder and Turbot of the 0-Group caught
at the Danish coasts per 30 min. haul.

	1945			1946			1947			1927—47	
	No. of Stats.	Floun- der	Tur- bot	No. of Stats.	Floun- der	Tur- bot	No. of Stats.	Floun- der	Tur- bot	Floun- der	Tur- bot
N. Kattegat	0	—	—	10	0	0	20	0	0	0.3	0.4
C. Kattegat	0	—	—	16	0	0	18	0.5	0.5	0.3	0.2
S. Kattegat	19	0	0	20	0	0	20	0	0	0.2	0.3
Sound	19	1	0	17	19	0	22	14	0	10	0.2
Belts	92	2	0	51	0.2	0	71	31	0.3	4	0.2
W. Baltic	44	0.7	0.1	13	2	0	31	4	0.1	2	0.1



Fig. 1. Number of Plaice of the 0-Group (year-class 1947) taken per fishing unit in the summer of 1947).

The fishing unit used was a 30 minutes' haul with Johansen's young plaice trawl.

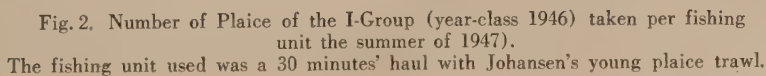


Table 6. Number of Turbot of the 0-Group and I-Group caught at the Swedish coasts per 30 min. haul.

	No of Stats.	1945		No. of Stats.	1946		No. of Stats.	1947		1929—38	
		0-Gr.	I-Gr.		0-Gr.	I-Gr.		0-Gr.	I-Gr.	0-Gr.	I-Gr.
Skagerak	30	1	0.1	27	0.6	0	26	0.8	0	0.6	0.1
C. Kattegat	8	1	0.3	8	0.2	0	8	8	0	2	0.1
S. Kattegat	22	6	0.3	22	1	0	28	4	0	4	0.4
Sound	4	0	0	0	—	—	6	3	0	0	0.5

The 0-group of the turbot is usually more numerous at the Swedish coast of the Kattegat than at the Danish.

In the southern and eastern parts of the Kattegat the number of 0-group turbot in 1947 was about average or greater, in the other areas it was very small. Especially in the Kattegat good spawning years for turbot are rather rare.

Aage J. C. Jensen and Arvid R. Molander.

2. Limfjord and Isefjord.

The number of plaice caught with the eel-tog per 30 minutes in the broads of the Limfjord is shown below. The numbers in brackets give the average number during the period 1927 to 1939.

	Nissum	Venø-Kås	Sallings.
June	398(356)	7.0(84)	9.7(46)
Sept.	766(481)	13.6(92)	2.0(12)
Mean	582	10.3	5.8
	Livø	Thisted	E. of Salling
June	2.7(5.5)	8.2(12)	0.6(5.0)
Sept.	0.3(2.4)	1.5(3.6)	0.0(1.1)
Mean	1.5	4.8	0.3

The stock of plaice in all broads except Nissum Broad was below average and in Livø Broad, for instance, the stock was the smallest since 1933.

In Nissum Broad the stock was a little above normal during the spring. In August, however, the stock was about 50 % above normal. Thus the immigration from the North Sea into the nursery grounds of Nissum Broad has been unusually large.

The composition of this stock will be seen from the following analysis:

Age-Gr.	Year-Class	June	September
0	1947	0(0)	1.7(40)
I	1946	28(76)	102(224)
II	1945	132(154)	371(149)
III	1944	170(103)	240(62)
IV+	1943—	68(27)	50(17)

The numbers in brackets indicate the average values for 1927 to 1939. It appears that the stock is dominated by the 1944 and 1945 year-classes, while the 1946 and 1947 year-classes are far below the average.

The numbers of flounder caught with the eel-tog per 30 minutes in various areas of the Limfjord were as follows:

	E. of Salling	Livø Br.	Sall.-Vodstr.
June	2.8(2.6)	6.0(3.4)	0.3(1.1)
Sept.	0(0.4)	3.5(2.6)	1.7(0.4)
Mean	1.4(1.5)	4.7(2.8)	1.0(0.7)
	Venø-Kås	Nissum	Thisted
June	0.8(1.3)	0.7(0.5)	5.3(1.9)
Sept.	1.3(0.4)	0(0)	0.3(0.7)
Mean	1.0(0.8)	0.3(0.3)	2.8(1.3)

The numbers in brackets indicate the mean of the years 1927 to 1946. It appears that by far the greatest part of the stock in the Limfjord was in the central part (especially in Livø Br. and Thisted—Visby Br.) while the stock in the western part (Nissum Br.) was very small. Furthermore it will be seen that in 1947 the stock has been above normal in all areas, while in some (Livø Br. and Thisted—Visby Br.) it was considerably above normal. The fluctuations in the stock in the Limfjord will appear from the following list, giving the number of flounder obtained per 30 minutes with the eel-tog (all districts of the Limfjord):

1927-32	1933-36	1937-39	1940-42	1943-46	1947
1.6	1.1	0.9	1.7	0.9	1.9

The number of fin rays in the anal fin was 40-60 (103 individuals examined).

In the area Roskildefjord-Isefjord the stock is much denser than in the Limfjord. The number caught with the eel-tog per 30 minutes amounted to 12. The number of fin rays was 40-60 based on 115 specimens.

The age composition and mean length of the age-groups of the flounder from the two areas was as follows:

Group	Limfjord		Roskildefjord-Isefjord	
	No.	Av. Length cm.	No.	Av. Length cm.
I	1	—	18	22.6
II	62	20.5	95	24.5
III	23	23.1	3	35.0
IV	14	28.6	0	—
V+	3	33.0	0	—

Table 7. Length Composition of Plaice (per cent.) in the Kattegat and the Northern Belt Sea.

	Depth m.	No. of samples	26—30 cm.	31—35 cm.	36—40 cm.	41—45 cm.	Total	Mean cm.
SW. of Østre Flak								
1946 July—Aug.	13	3	85	13	1	0	99	28.8
1947 Aug.	12	1	100	0	0	0	100	28.0
NE. of Tangen (N. of Djursland)								
1946 Sept.—Oct.	11	3	78	19	4	0	101	29.8
1947 Sept.	10	1	29	65	6	0	100	31.5
Near Fornæs (N. of Grenaa)								
1946 Sept.—Oct.	14	1	33	62	5	0	100	32.1
1947 Aug.	18	1	36	59	5	0	100	32.2
N. of Schultz' Grund								
1946 Sept.	21	1	37	45	9	9	100	33.0
1947 Sept.	22	1	35	59	6	0	100	32.0

It is characteristic that in the Roskildefjord the stock consists of young individuals, very few being older than 3 years. In the Limfjord, however, a considerable proportion of the stock belongs to older age-groups. The average length of the age-groups is much greater in the Isefjord than in the Limfjord.

The number of **dab** caught in Nisum Broad (western part of the Limfjord) with the eel-trawl was 21 individuals per 30 minutes (average for June and September). This is far below the normal number obtained, the average number for the period 1927 to 1946 being 79. The decrease of the stock, which started in 1930, has thus continued. The stock consists mainly of young immature specimens. The dab does not spawn in this area. The composition of the stock was as follows: I-group: 26 specimens, II-group: 5 specimens.

Jørgen Knudsen.

Size and Age-Composition of Commercial Catches.

The market measurements of representative samples, taken at random, has been continued at the fishing harbours of Skagen, Frederikshavn, Grenaa and Bagenkop.

In the northern Kattegat the majority of the plaice which were found in this area in 1946, had been caught; yet the average length of the plaice was still about the same as in 1945, i.e., somewhat greater than before the war.

The plaice which had grown to a greater size than normal in the areas closed to the fishermen during the war on account of mines, had their greatest effect on the average length of the plaice

in 1946. In depths of over 15—20 m. in the northern Kattegat the average length was as high as 35 cm. In none of the catches from this area investigated in the summer and autumn of 1947 was it more than about 31 cm.

In the central and southern Kattegat the mean length of the plaice was about the same as in 1946, in some cases it was a little less, in others a little greater (see Table 7).

In the southern part of the Belt Sea the average length of the plaice caught increased, as seen from Table 8 of catches from Bagenkop. This increase in the length is due to the fact that the average age of the plaice caught in 1947 was about a year higher than in 1946. In both of these years it was the rich 1944 year-class which constituted the main part of the catch.

Aage J. C. Jensen.

Transplantation.

The Belt Sea and surrounding waters. In April and May 1947, transplantations were carried out on the same scale as in the previous years (Ann. Biol. III). The plaice were caught in Nisum Broad and transported in well-smacks to the places of liberation. The water during the transportations was cold, so, even on the voyage from Thyborøn to the Belt Sea, only few of the fish died (1.4%). The following weights and numbers were liberated:

	kg.	No. of individuals
Southern Kattegat	11,690	155,500
The Sound	8,200	109,100
Northern Belt Sea	20,980	263,700
Southern Belt Sea	20,450	263,200
Total	61,320	791,500

Table 8. Length Composition (per cent.) at the southern end of the Great Belt.

	Depth m.	No. of samples	26—30 cm.	31—35 cm.	36—40 cm.	41—45 cm.	46—50 cm.	Total	Me cm
Ristinge Bay									
(W. of S. Langeland)									
1946 Sept.—Oct.	9—16	2	69	24	7	0	0	100	30
1947 Oct.	15	1	50	38	12	0	0	100	31
C. 4 Sm. SE. of Kels Nor									
(S. end of Langeland)									
1946 Sept.—Oct.	23—24	2	53	42	5	0	0	100	31
1947 Sept.—Oct.	23	2	26	44	28	2	0	100	34
S. of Lolland									
1946 Oct.	9—26	1	85	15	0	0	0	100	28
1947 Oct.	11—23	1	35	56	0	4	4	99	32

Aage J. C. Jensen

The mean length was 19.2 cm. (17—25 cm.) and the mean weight 78 g. per individual.

Percentage of each Age-Group.

II	III	IV	V
4	42	52	2

The IV-group was very abundant in 1947.

200 of the plaice were marked. Of these 100 (DaA. 201—300) were liberated near Taarbæk in the Sound. Until January 1948 only 9% were recaptured, these showed a growth of 9 cm. from April to November. The numbers DaA 301—400 were liberated north of Endelave in the Northern Belt Sea; 19% were recaptured (Jan. 1948), and they showed a growth of 7 cm. (Apr.—Nov.). A great number were recaptured a few months after liberation.

During the autumn plaice from the Belt Sea were analysed at the Danish Biological Station. The percentage of transplanted fish was only 2.4.

The Limfjord. In April 70,000 kg. or 940,000 individuals were transplanted in well-smacks from Nissum Broad to the inner part of the Limfjord. The transplanted fish had a mean length of 18.9 cm. (17—25 cm.) and a mean weight of 75 g. In Løgstør Broad 100 of the transplanted plaice were marked (DaA. 1—100), and of these, 37% were recaptured by 31st December 1947, a great number being caught a few months after liberation. In the same way 100 marked plaice were liberated in Nibe Broad. 25% were recaptured, and they showed a growth of 10 cm. (April—December).

As a control 100 of the plaice in Nissum Broad were marked. By January 1948 10% of these had been recaptured. In Nissum Broad the growth was 2 cm. from April to November, but in the North Sea, where some of them were recaptured, the growth was 7 cm. in the same space of time.

2000 of the plaice in Nissum Broad were analysed during the investigation carried out in con-

nection with the transplantations. Counts were made of the numbers of anal fin rays in young plaice caught in Nissum Broad. The 1945 year-class was found to have an average of 54.04 anal fin rays. This is in good agreement with Dr. Jensen's and Dr. Poulsen's investigations of former year-classes (Ann. Biol. III). They found a considerable positive correlation between the number of fin rays and the temperature of the bottom water from January to March, i.e., the period when the development of the larvae in the eggs takes place.

Year-Class	Mean number of anal fin rays	Temp. (30 m.) in Jan —March at Læsø Trindel L. V.
1944	54.48	5.1
1945	54.04	4.8

J. B. Kirkegaard.

Herring.

The Trawl Fishery at the Skaw.

During the winter and spring season of 1946/47 9 samples were analysed (between 28.11.46 and 4.5.47).

The length of these herring ranged from 12 to 30 cm., very nearly the same as in the 1945/46 season.

Many of the catches consisted partly of small herring, mostly under 15 cm., which were sold to the fish meal factories and as food for fish ponds. However, the catch of these small herring was limited particularly due to the regulation that catches containing more than 50% of small herring (or more than 45 specimens per kg.) must not be landed (cf. Ann. Biol. III, p. 103).

For each sample the mean number of the racial characters has been calculated; the means of these values are given in Table 9. Only samples of more than 20 specimens are considered here.

Table 9.
Racial Characters.

(No. of individuals in brackets).

	V. S.	V. P.	K ₂
Maturity I—II—III			
Sample			
Man: 56-44 (797)	23-96 (797)	14-50 (739)	
Age: 56-21—56-68	23-91—24-04	14-32—14-63	
Sample 10/12			
Man: 56-51 (57)	23-77 (57)	14-84 (57)	
Maturity VII—VIII			
Man: 56-43 (301)	23-92 (301)	14-95 (299)	

It is seen that most of the samples of herring (samples) of maturity I—II—III had similar racial characters, and that the same was the case for those of maturity VII—VIII; but it is also seen that these two groups differed very much as to K₂. In one catch of immature herring, caught 11.12.46, only those which were 18—20 cm. long had the same racial characters as the other samples of immature herring investigated during this season (namely V.S.: 56-21 (68), V.P.: 24-04 (68), K₂: 14-43 (63)), while the smaller fish, of 14—17 cm., had the racial characters shown in the table, i.e.,

they were summer or autumn spawning herring from the western North Sea.

The herring of maturity VII—VIII were identical with the summer and autumn spawning herring of the western North Sea. The herring of maturity I—II—III which have practically the same V.S. and V.P. but a lower K₂ (14-3—14-6) are somewhat difficult to place. Those whose V.S. is about 56-35 and K₂ about 14-6 cannot be Kobbergrund herring which have a much higher V.P. Also the autumn spawning herring from the Jutland Bank, for which A. C. Johansen found V.S.: 56-3, V.P.: 24-2 and K₂: 14-6, differ from them in having a higher V.P. Most probably they are Shetland herring or autumn spawners from north-west Scotland (Minch herring)¹⁾ for which we do not know the V.P.

The herring in the two samples with the lowest V.S. were no doubt mixed with spring spawners of the Kattegat while the two with the highest V.S. must have been mixed with North Sea spring spawners.

In the 1945/46 season almost all the immature herring were typical summer and autumn spawning herring of the western North Sea.

¹⁾ H. Wood: Race investigations of the herring population of Scottish waters. Fishery Board for Scotland, Sci. Invest. 1936, III.

Table 10. The Spring and Autumn Fisheries in the southern Kattegat and the Belt Sea, during 1947.

Locality	Date	Gear	Maturity (per cent.)						VIII
			I-II	III	IV	V	VI	VII	
Hundested	May 20th	Pound net	0	1	68	25	6	—	—
Assens									
(S. Lillebælt)	May 16th	„ „	40	29	4	4	15	7	1
Hundested	Oct. 28th	„ „	61	23	3	14	0-3	—	—

Size Distribution (per cent.)

Locality	cm. 13/14	15/16	17/18	19/20	21/22	23/24	25/26	27/28	Mean
Hundested (May)	—	—	—	15	54	15	12	1	22-5
Assens	—	—	—	16	52	23	8	—	22-4
Hundested (Oct.)	6	5	26	23	16	11	12	1	20-8

Racial Characters (No. of indiv. in brackets).

Locality	V. S.	V. P.	K ₂
Hundested (May)	55-85 (119)	23-55 (119)	14-12 (119)
Assens	55-75 (120)	23-54 (120)	14-19 (118)
Hundested (Oct.)	Mat. I, II, III	23-53 (142)	13-98 (139)
	Mat. IV, V, VI	23-79 (38)	14-03 (38)

Age Composition (per cent.)

Locality	Winter rings	0	1	2	3	4	5	6	7	Total
Hundested (May)	—	—	—	72	12	5	7	4	—	100
Assens	—	—	—	61	25	13	—	—	1	100
Hundested (Oct.)	Mat. I, II, III	4	33	22	8	9	5	2	—	83
	Mat. IV, V, VI	—	4	6	3	1	2	1	—	17

Most of these immature herring were 1-ringed in both seasons, and it cannot be determined whether this great change is due to differences in the strength of the year-classes in the various races or to differences in the distribution of the young herring.

S. Kattegat and Belt Sea.

In the two spring samples there may seem to be a small difference between the V.P. of the immature which is about 23.45 and the V.P. of the full and just spent herring which is about 23.75. From the low value of the V.P. of the immature herring we can be sure that they are spring spawners. The immature herring caught at Hundested in October are also seen to be spring spawners, constituting 83 per. cent. of the number of herring caught.

A sample of small herring, 9–13 cm. in length, caught in the eel-seine from the M/B "Havkatten" in the Roskilde Fjord in June had the following racial characters V.S.: 55.71 (83), V.P.: 23.65 (83) and K₂: 14.17 (41). It is quite evident, that they are Kattegat spring spawners.

Thus there has not as yet been found any indication of a new good year-class of autumn spawning herring.

The yield of the autumn herring fishery was very small, as it has been each year since 1943.

The Herring in the Limfjord.

Two samples were investigated: in January 1947 a sample of small herring caught in a trawl in Sallingsund, and in May a sample of mature herring caught in pound-nets in Hvalpsund.

The racial characters of the herring were the following (numbers investigated in brackets).

Size, cm.	Rings	V. S.	V. P.	K ₂
Jan. Sallingsund				
11—12	0	56.34 (56)	23.77	14.39 (116)
13—15	0	56.47 (75)	23.96	14.89 (82)
15—18	1	56.47 (31)	23.90	14.74 (35)
May. Hvalpsund				
18—27		56.67 (162)	23.58	14.06 (162)

It is seen that the smallest of the trawl-caught herring were mixed with some spring spawners, while the larger ones, both of the 0- and 1-ringed, were typical autumn spawners of the western North Sea. The occurrence of the young herring of this race seems to change a good deal from year to year; they were very common in the Limfjord during 1939 to 1945, but were not represented in four samples investigated in 1946. The mature herring caught in May were typical spring spawners of the Limfjord. They were about 23 cm. long and mostly 3–4 years old.

Age J. C. Jensen.

Eel.

Occurrence in the Limfjord and the Isefjord.

In 1947, the following numbers of eels were caught with the eel-tog per 30 minutes in the different parts of the Limfjord.

	Nissum Br.	Kås Br.	Salling-Vod.
June	0.9 (0.9)	0.3 (0.7)	1.0 (1.0)
Sept.	0 (0.2)	1.0 (1.5)	0.7 (1.8)
Mean	0.5 (0.6)	0.7 (1.1)	0.9 (1.4)
	Livø Br.	Thisted Br.	E. of Salling
June	1.2 (1.1)	0.4 (1.3)	0.7 (1.2)
Sept.	1.5 (2.5)	1.1 (4.0)	3.0 (2.8)
Mean	1.4 (1.5)	0.8 (2.8)	1.9 (2.2)

The numbers in brackets give the mean value for the period 1927 to 1946. From the table it will appear that the stock of eel was considerably below normal in almost all districts, a decline which was caused, no doubt, by the severe winter of 1947. A similar decrease was noticed during the years 1939 to 1943 when 3 severe winters followed one another. During the years 1944, 1945 and 1946 a slight increase took place.

In the Isefjord-Roskildefjord area investigations were carried out with S/S "Biologer" in June and with a motor boat in September. The number of eels caught per 30 minutes with the eel-trawl appears from the following figures:

	Roskildefjord	Isefjord
June	165	21)
Sept.	25	202)

1) Mostly in the outer part of the fjord.

2) Mostly in the inner part of the fjord.

The eel-trawl is a more effective implement for catching eel. At 10 stations in the outer part of the Isefjord in June 1947 0.9 eels were caught per 30 minutes with the eel-tog, showing that in this part of the Isefjord where the density of eels is the smallest it is about the same as in the Limfjord. The figures above show that the density is very much greater in the other parts of the Isefjord complex.

Jørgen Knudsen.

Fish for Processing.

The Danish fishery for the fish-meal factory and food for the fish ponds has been continued the same extent as in 1946, or a little less, but no yet statistics are not at hand.

In most of the catches landed at Skagen, from a third to more than a half consisted of whiting while the rest was mostly small herring and sprat. In some landings "poor cod" was present with

all percentage of many different species. Some of the landings of fish for processing consisted exclusively of small herring and sprat which had been caught together with larger herring.

Aage J. C. Jensen.

Marketable Crustaceans.

Lobster. The statistics collected from 28 fishermen along the Skagerak coast gave a total number of 12,371 lobsters, as against 11,707 in 1946 (27 fishermen). The number of traps employed was larger in 1947, the average catch being 6.20 as against 6.65 in 1946.

As in earlier years the catches per trap were larger in the eastern than in the middle and western districts, the numbers being 14.2, 6.5 and 4.1 respectively, as against 15.9, 7.3 and 4.0 in 1946.

Alf Dannevig.

Norway Lobster. During the period from October 1946 to September 1947 several unsorted samples from commercial catches were examined. The catches originated from the north and north-west of the coast, in which area the majority of the Danish fishery for Norway Lobster is now carried out. Before the war the northern Kattegat was worked much more. Figure 3 shows the length distribution computed from all samples, females and males being plotted separately. The samples contained 570 males and 113 females, the males, as is normally the case, forming the majority. Only a very small proportion of the females obtained by the commer-

cial fishery carried eggs; in the samples dealt with here only a single female carried eggs. The marked difference from the pre-war years when 25 % of the females carried eggs, and when the sizes of the males and females were also different, may be due to the change in fishing grounds.

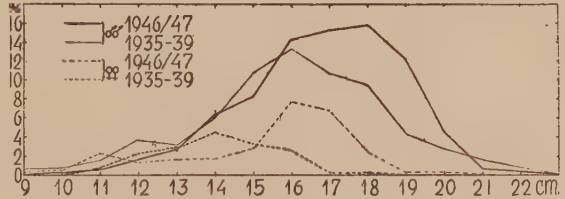


Fig. 3. Length Distribution of Norway Lobsters.

Deep Sea Prawn. A number of unsorted samples of commercial catches were examined. All the samples taken together contained 742 males and 673 females. Transitional stages were observed during the winter only. Females carrying eggs were found in the samples from late autumn and spring (no samples were available from the winter time). The lengths of the males varied from 8 to 12 cm. (total length) while the females ranged from 11.5 to 15 cm.

Jørgen Knudsen.

Oyster. The oysters in the natural ponds thrived well in spite of the very cold winter and heavy ice. The collecting of oyster spat gave poor results both in the sea and in the pond.

Alf Dannevig.

Baltic Area.

INTRODUCTION.

CONTRIBUTIONS to this report have been received from Dr. Aage J. C. Jensen, Copenhagen, Dr. H. Alander, Stockholm, Dr. Chr. Hessle, Stockholm. Through Dr. Gucki, Gdynia, several reports of Polish investigations in the south-eastern part of the Baltic have been received from A. Glowinska, W. Mankowski, F. Chrzan, K. Demel and Mulicki.

The winter 1946—47 was very cold, but the summer months of 1947 were hot. As a consequence of these weather conditions the temperature of the upper water layers was comparatively low during the first four or five months of 1947 but high during the rest of the year. Danish (Jensen), Polish (Glowinska) and Swedish (Alander) observations showed that the salinity of the deeper water layers in the southern part of the Baltic increased considerably during 1947. This Alander attributes to an extraordinarily strong influx of salt water during the summer. This influx seems, however, not to have reached the central and northern parts of the Baltic, where the hydrographic conditions were more normal.

Alander has made investigations of the hydrogen-ion concentration of the different water layers in some parts of the Baltic. Of special interest is his observation that the pH decreased in those water layers where fish shoals were reported by the echo sounder.

W. Mankowski has given a review of the occurrence of pelagic eggs and larvae of fish in the Gulf of Gdansk in order to determine the duration of the spawning period of different species. His observations give a clear view of the very long spawning period of some of these species in the Baltic, as for instance those of the cod, sprat and *Os cimbrius*.

Aage J. C. Jensen has continued his observations on the fat content of the plankton and has

stated that the average fat content of the plankton in the Bornholm Area was lower in 1947 than in the years from 1941 to 1946.

Nearly everywhere in the Baltic the commercial herring catches have decreased during recent years and in 1947 the herring fishery in general was very bad. Both Aage J. C. Jensen and H. Alander are of the opinion that these conditions are due to the fact that no really strong year-classes have appeared since 1938. In 1947 some catches, especially those from the deeper parts of the Baltic, contained a rather large percentage of herring belonging to the 1936 and 1937 year-classes, but on the whole these old herring are now of little importance.

According to Jensen's and Alander's investigations the strongest year-classes after 1938 seem to have been that of 1945 in the southern and those of 1943 and 1944 in the central and northern parts of the Baltic. Apart from the insufficient recruitment, Jensen is of the opinion that the failure of the fishery in 1947 may be ascribed to the high temperature during summer and autumn and to the poor plankton conditions.

Chr. Hessle calls attention to the remarkable increase in the catches of cod in the Baltic during recent years and the occurrence of cod now also in the northernmost part of the Gulf of Bothnia which may be considered as a parallel to the great extension of the area of distribution of this species in the Arctic Sea during recent years. The stock of Baltic cod seems to have been comparatively unaffected by war conditions.

F. Chrzan gives an analysis of the commercial catches of cod in Poland during 1947. Among other things he points out the fact that the spawning period lasts from April till November which is in agreement with the result Mankowski has obtained from the catches of eggs and larvae. Both Chrzan and Mankowski have also found

that the spawning in 1947 reached its maximum as late as in June and July which Chrzan ascribes to the long winter of 1946/47. Chrzan also states that the maturity of the gonads in males occurs earlier than in females and that the expulsion of sperm during spawning lasts longer than that of eggs.

Investigations with the sprat trawl, carried out by Alander in the Bornholm Area in May 1947, showed that the I-group of cod and other demersal species was at that time relatively rare. Similar investigations in the same area in December gave quite a different result. The catches contained not only numerous codling but also a large number of small whiting besides some small individuals of *Drepanopsetta platessoides* and *Caranx trachurus*, two species which are rarely met with in this area. The large number of codling and small whiting and the presence of the last named two species Alander ascribes to the strong influx of salt water during the summer.

According to Alander the Bornholm Area regularly receives an influx of salt water during autumn or the early winter months. As the larvae of the demersal fish at that season have reached the bottom stage they are not carried away by the current, and consequently at this time comparatively few young fish are brought to this area from

outside. But when, as in 1947, a strong influx appears during the summer, when the larvae are still quite young, they may be more easily transported by the current. Alander considers that this explains the appearance of the large number of young cod and whiting as well as of *Drepanopsetta* and *Caranx* in December 1947. He is of the opinion that the stock of Baltic cod during normal conditions is dependent principally on the spawning in the Baltic, but that it sometimes receives great contributions of larvae from outside when, as in 1947, hydrographic conditions are favourable.

Age J. C. Jensen reports a very small number of the 0- and I-group of flatfish, especially of plaice, in catches with the Johansen young-plaice trawl and the hand push-net in 1947, which corresponds to the low temperature of the water during March and April. Swedish investigations have given the same result.

K. Demel has analysed some catches of *Onos cimbrius*. He found that the fifth age-group predominated in the catches of this species, that the average number of vertebrae was 53.9 and that the males were more numerous than the females. The material also seems to indicate a rather extensive spawning period of *Onos cimbrius* lasting from spring to the end of the summer.

Chr. Hessle.

ENVIRONMENT.

Hydrography.

The winter of 1946/47 was extraordinarily severe, heavy ice had developed over the whole Baltic, as soon as the ice had melted there was a short transition to an extraordinarily warm, dry and calm summer. As was to be expected, these extraordinary climatic conditions have had a distinct influence on hydrographic conditions.

In the **Bornholm Deep**, the salinity, which had been high during the first years of the forties, showed a steep decline in 1944, and remained low in the following years; in 1946, it rose again somewhat and during the winter of 1946/47 a strong inflow of salt water to the Bornholm Deep took place. In May 1946, the salinity at 90 m. had risen somewhat above 18 ‰ (Diagram, Fig. 1). The surface temperature had already risen perceptibly, at 50 m. it was not more than about 0.5° —

to be expected. With these values, there is no risk of suffocation, especially because the partial pressure of the oxygen is higher as a result of the higher temperature.

The occurrence of the extraordinarily warm and salt water may be explained as a result of the warm and dry summer. The discharge of fresh water to the Baltic was very small, which resulted in a similarly small outflow of Baltic water to the Kattegat, especially from June to July and during September (see Table 3, p. 126, Current at Halskov Rev). The warm surface water from the Kattegat could therefore pass into the Baltic through the Sound without being hindered to any extent by the outflowing water; neither did it mix, and so could spread as a bottom layer due to its relatively high specific gravity.

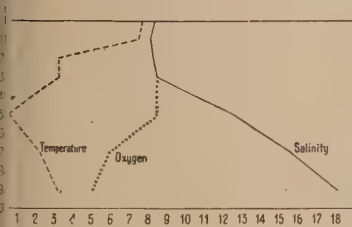


Fig. 1. May.

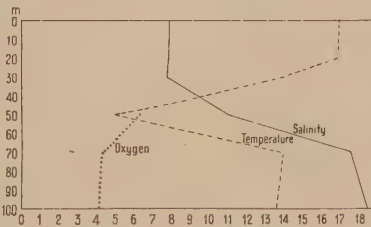


Fig. 2. September.

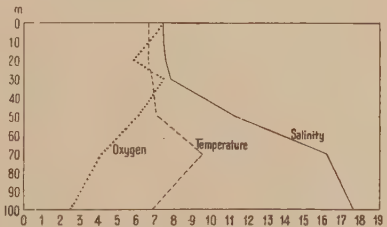


Fig. 3. December.

Figs. 1—3. Salinity, Temperature and Oxygen Content in the Bornholm Area during 1947.

probably a result of the cold winter. At 90 m. depth the temperature was somewhat above 3°, that is but normal. The oxygen content was also normal at this depth — about 5 ml./l. In September the salinity reached 18.43 ‰ at 100 m. (see Diagram, Fig. 2) which is supposed to be the highest value ever observed in the Bornholm Deep. Most extraordinary, however, was the temperature distribution. According to expectations the temperature of the surface layer was high and constant and well defined against the still cold layers below at about 50 m. depth. But the bottom layer had a specially high temperature, i. e., more than 13.5°, which is undoubtedly a record for the bottom water of the Bornholm area. Water of exceptionally high temperature (about 10°) has certainly been found before (1929, 1937 and 1945) in the southern Baltic, but then it had a low salinity (about 12—13 ‰) and occurred in the medium layer at 50—70 m. depth. The combination of both high salinity and high temperature must be considered very unusual, and as a result definite influences on the fauna of the southern Baltic may be expected. The oxygen content of the bottom water was somewhat lower than in the spring, but it may be considered normal. The watering so warm the oxygen consumption was however not high and the decline in oxygen was therefore

In December, the situation had again changed (Fig. 3). Even if the salinity of the lower layers continued to be very high it had perceptibly decreased; at 100 m. it was about 17.5 ‰. The temperature also had decreased considerably, but was still above normal at 50 m. and below. The oxygen content had also decreased considerably (about 2.5 ml./l. at 100 m.) — probably incidental to the increased oxygen assimilation caused by the unusually high temperatures in the bottom waters.

In the **central Baltic** the salinity had been very low in the late thirties, but together with the increased salinity of the southern Baltic the inflow of more saline bottom water became stronger; this caused the salinity to rise and the boundary between the higher and the lower layers — which up to then had been rather diffuse — to become more marked. The lower salinity in the southern Baltic of recent years has evidently until 1947 not been able to exert any influence on the conditions in the central Baltic, for in June 1947 (Fig. 4) the salinity continued to be high — between 10.5 and 11 ‰ at 70 m. and more — at Knolls Ground between Gotland and the mainland. As far as the temperature is concerned — it was between 4 and 4.5° at 70—100 m. — no great changes seem to have taken place in the lower layers which were evidently very homogeneous.

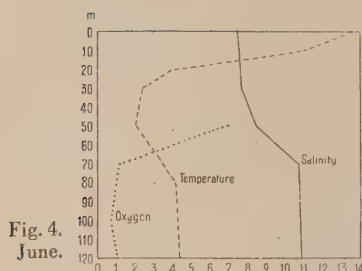


Fig. 4.
June.

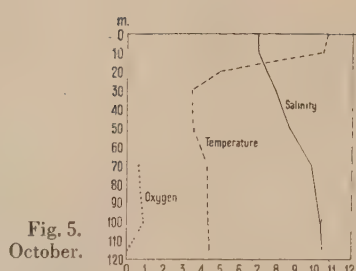


Fig. 5.
October.

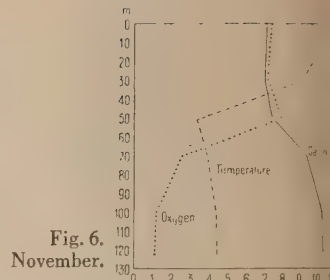


Fig. 6.
November.

Figs. 4—6. Salinity, Temperature and Oxygen Content in the Central Baltic during 1947.

Between 70 and 20 m. there still remained a deep cold-water layer from the severe winter, but in the surface layers the process of warming-up had made very good progress and had given rise to a discontinuity layer between 10 and 20 m. In the central Baltic the oxygen content of the bottom water is usually very low, often below 2 ml./l. In the series of samples dealt with here it was about 1 ml./l. at 70 m. and below, that is extraordinarily low; it is undoubtedly due to slight intermixing in the lower layers.

Owing to the calm weather during the summer there was also remarkably little intermixing in the upper layers. Observations off Hävringe (Fig. 5), however, showed a very slight equalising of the salinity distribution, but the boundary between the warmer surface water and the colder layer underneath continued to be sharply defined, and the temperature did not change towards the bottom. At 70 m. the oxygen content was remarkably low and it had totally disappeared at the bottom — 115 m. — where sulphurous smells were observed.

Investigations off Hävringe in the beginning of November showed that the layers of fairly uniform temperature and salinity had considerably increased and that the transition between the less saline surface layer and the more saline bottom layer was more pronounced than before. The warm surface water extended downwards, even beyond 30 m. Since

the extent of a layer may be subject to sudden change under the influence of wind conditions, we can deduce definite conclusions from the observations but they seem clearly to indicate a regular seasonal event, that is, at the beginning of winter the upper layers mix as they are cooling. The oxygen content of the deeper layers continued to be low, at 70 m. a value somewhat higher than usual was observed — about 2.5 ml./l. Since the salinity at this depth was somewhat lower than usual, it seems as if a certain change in the boundaries between the layers had taken place even at greater depths.

The inflow of more saline water from the south to the Bothnian Sea is not very strong, and therefore the difference in salinity between the surface and the bottom layers is quite insignificant. Especially before the formation of ice and after melting, when the water has the same temperature from the surface to great depths, no great forces are needed to mix even a large part of the water masses. Observations in the Bothnian Sea east of Agö Light in the beginning of July showed the salinity to be about 6‰, which must be called remarkably high (see Fig. 9). The difference in salinity between surface and bottom water was very slight. The temperature at the surface was quite high — somewhat above 14° — it fell rapidly and rather regularly towards the bottom, and at 50 m. depth it was hardly 3°. A sample taken in October not very far from the former place



Fig. 7. July.

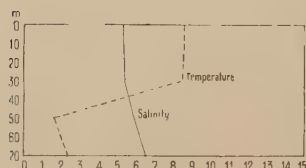


Fig. 8. October.

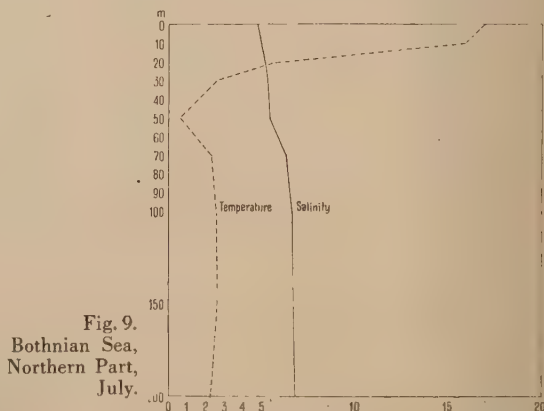


Fig. 9.
Bothnian Sea,
Northern Part,
July.

Figs. 7—9. Salinity and Temperature in the Bothnian Sea during 1947.

ved quite homogeneous water from the surface to 10 m., as regards both salinity and temperature. The salinity of this surface water was somewhat lower than in summer, but below 30 m. it rose again perceptibly and at 70 m. it reached the relatively high value of 6.44 ‰.

From a series of observations taken in the middle of July at the deepest part of the Botten Sea Ulvödjupet — it is seen that at 70 m. and farther down the water was very uniform, in both temperature and salinity (see Fig. 9). The chief displacements of the water seem to take place in the upper layers while the bottom water is relatively

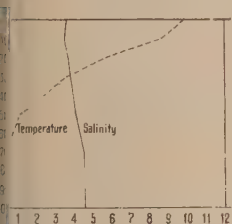


Fig. 10. Salinity and Temperature in the Bothnian Bay, July 1947.



Fig. 11. Values of pH at different Depths in the Central Baltic (Dec.), off Håradsskär (Nov.) and at Hävringsö (Nov.).

stationary. But this must not lead us to believe that the bottom water is as stationary as in the central Baltic; the oxygen content is very high all over the Bothnian Sea, even at the bottom. At 200 m. it was as high as 6.25 ml./l.

In the **Bothnian Bay** the hydrographical conditions are the same as in the Bothnian Sea, even though of course the salinity is lower. In the middle of July the salinity — as expected — was fairly regularly distributed, but it was relatively high, 6 ‰, at 100 m. The temperature decreased regularly from the surface down to 50 m. and at greater depths it kept between 0° and 1°. As in the Bothnian Sea the oxygen content was high, at the bottom as low as 8.9 ml./l.

During late autumn some determinations of the hydrogen-ion concentration were made at various places in the central and southern Baltic (see Fig. 11); a Taylor slide-comparator, with phenol-red and orthophenol-red as indicators was used. Sea water has a buffer effect, since the carbonic acid is partly combined with bicarbonate and carbonate, and therefore the pH variations were relatively small. In the Baltic, however, where the salinity is low and consequently the buffer influence weaker, relatively low pH values may be anticipated in the stagnant water layers of greater depths. Observations at Klinta's Grund in the beginning of December, for instance, showed a constant decrease in pH from 7.5 at the surface to 6.9 at 100 m. where it reached 6.9. Some observations at the end of November in the neighbouring sea — at Håradsskär and Hävringsö — showed re-

markably low pH values at lesser depths in water with high oxygen values, which must be considered quite unusual. Off Håradsskär the pH fell from 7.6 at 20 m. to 7.0 at 30 m. and reached the very low value of 6.8 at 50 m. This may perhaps be explained as follows:— According to the echo-sounder a strong shoal of fish — presumably herring — was present from the bottom up to 30 m.; they had probably exhaled so much carbonic acid that the pH was perceptibly influenced. Somewhat similar conditions prevailed at Hävringsö where the pH fell from 7.6 at 30 m. to 7.1 at 50 m. The echo-sounder proved the presence there of a shoal whose upper limit was sharply defined at some 40 m. In the southern Baltic no marked divergence from the anticipated pH values were found, but this may be due to the fact that no fish shoals were observed at the places where the samples were taken.

Harald Alander.

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Hydrography at Bornholm.

Hydrographic observations at different depths have been carried out in connection with the biological investigations from the Danish Biological Station.

The vertical distribution of temperature and salinity in 1946 and 1947 at neighbouring stations are shown in Table 1. It will be seen that the very

Table 1. Temperature and Salinity.

m.	SE. of Christiansø 17th Sept. 1946		SW. of Christiansø 15th Sept. 1947	
	°C	‰	°C	‰
0	15.0	7.4	17.2	7.3
20	14.8 ¹⁾	7.4 ¹⁾	16.8	7.3
30	13.5 ¹⁾	7.4 ¹⁾	16.6	7.4
40	9.0 ¹⁾	7.6 ¹⁾	9.2	7.7
45	4.2	7.9	5.7	8.6
50	4.5 ¹⁾	8.5 ¹⁾	4.5	11.1
55	7.6	10.6	4.5	12.7
60	4.8	13.0	4.7	14.3
70	4.8 ¹⁾	14.8 ¹⁾	4.7	16.7

¹⁾ Interpolated.

high temperature in 1947 reached to an unusually great depth, and that the intermediate warm layer at about 55 m. failed this year. The salinity at 70 m. was somewhat above the normal (Cf. Ann. Biol. II, p. 153).

Table 2.
Monthly Means of Surface Temperatures
at Christiansø

and Mean of 15 preceding years.

(From the Danish Meteorological Institute,
Nautical Department)

Month	X	XI	XII		I	II	III
Mean	11.6	8.2	5.4		3.3	1.8	1.6
1946	10.8	8.0	5.4	1947	2.5	0.1 ¹⁾	—
Month	IV	V	VI	VII	VIII	IX	
Mean	2.9	6.2	11.4	16.4	17.2	15.1	
1947	0.6	5.0	12.6	16.8	18.3	16.8	

¹⁾ No observations 25.—28. Febr. incl.

Age J. C. Jensen.

The Hydrography of the Gulf of Gdansk.

The observations concerned temperature, salinity, oxygen and phosphate content. Because of the very cold winter of 1946/47 the survey commenced as late as April.

The surface temperature, which was 0.45° on April 3rd, reached its peak on July 1st with the value of 23.2° C. A second maximum of about 20° was noted in the Bay of Puck on August 14th. The temperature stratification took place in the first days of April. The autumn mixing (in the Deep of Gdansk) reached the depth of 30—40 m., with a temperature of 6.60°—7.05°, on December 6th.

This summer the temperature at 100 m. was about 1.5° lower than in 1946. This is shown in

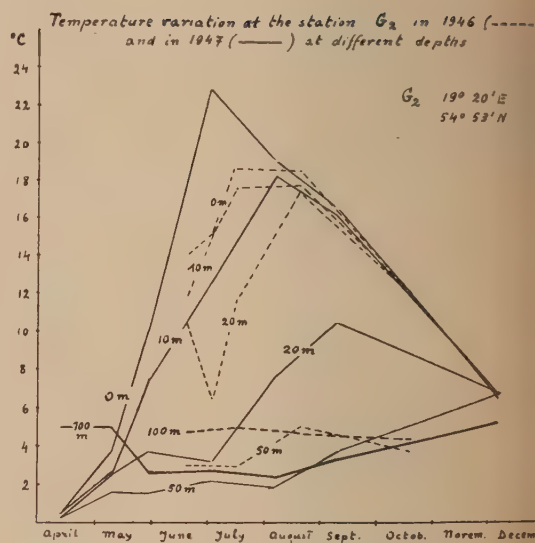


Fig. 12. Temperature Variations at Station G₂ in 1946 (broken line) and in 1947 (unbroken line) at various depths.

Figure 12 which represents temperature variations at station G₂, the deepest station worked. The discontinuity layer during the period from May 20 to September 13th lay generally between 10 and 30 m., and only once descended below 30 m. (September 13th). In the preceding year the upper stratum of warm water was considerably thicker.

The average salinity of the surface water layer amounting to 6.95 ‰, was lower than in 1946. The lowest salinity, 6.31 ‰, and the highest, 7.50 ‰, were observed in the Bay of Puck. The discontinuity layer was found at almost 50 m. The average salinity value at 100 m. in the Deep of Gdansk was considerably higher than last year. The salinity there increased continually after May 9th and on December 6th reached the value of 12.67 ‰ (see Table 3).

Table 3.
Salinity (in ‰) in the Deep of Gdansk.
(The average data from two stations periodically observed).

Depth m.	Year	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Yearly Average
0	1946	—	—	7.15	7.01	7.11	7.20	7.18	—	—	7.12
0	1947	7.32	6.92	—	6.73	7.00	7.17	—	—	6.89	6.95
50	1946	—	—	7.27	7.61	7.45	7.21	7.67	—	—	7.50
50	1947	7.41	7.41	—	7.51	7.50	7.77	—	—	8.16	7.60
80	1946	—	—	10.55	10.75	9.25	7.39	9.94	—	—	9.93
80	1947	10.52	10.55	—	11.03	11.18	11.80	—	—	12.13	11.19
100	1946	—	—	11.52	11.68	11.09	—	11.02	—	—	11.40
100	1947	11.22	11.52	—	12.25	12.12	12.48	—	—	12.68	11.97

The oxygen content was rather high compared 1946, and reached its maximum, on the surface, May 29th with 114 % of saturation.

In the upper water layers during the spring and later the presence of phosphates was proved only occasionally, below 30 m. they varied from 0 mgm. to about 40 mgm. P_2O_5 per m^3 . Their distribution was rather irregular, probably owing to strong water currents in this area.

A. Glowinska.

Plankton Conditions at Bornholm.

The fat content was determined according to Wimpenny's method at three stations on Sept. 15th 1947 in hauls from the bottom to the surface. The following values were found: Davids Bk., N. of Bornholm, 10.9 %; NE. of Davids Bk., 15.8 %; off Gudhjem, 18.4 %.

The average of these samples is 15 %. Naturally they are too few to determine the real average fat content for the autumn of 1947, but it might be noted that the averages for the years 1941 to 1946 varied between 16 and 33 %.

Aage J. C. Jensen.

THE FISH.

Renewal of the Fish Stocks by Transport from the Kattegat.

The occurrence of large numbers of small whiting in the Bornholm Basin indicates that enormous quantities of fry and young fish are transported by inflowing water from the Kattegat; greater numbers of whiting can hardly be expected to spawn in the southern Baltic. Similarly, a large proportion of cod, by rate, of the high percentage of small fish in the stock of cod must be expected to have come from the same quarters. Several times before we have ascertained that the stock of cod had received a strong addition of young recruits as the whiting of the southern Baltic increased. In these years the addition also of whiting and other species from the Kattegat ought also to have been much greater than when the bulk of the recruits had come from areas outside the Baltic.

A strong inflow of salt water may thus possibly, not necessarily, carry a strong addition to the stocks of the Baltic. The strongest inflows are generally in the autumn and early winter. The fry of most species have usually by then developed from the pelagic to the bottom stage, and must be supposed to keep at the bottom and to follow the current. Usually, there is an extensive mixing of incoming and outgoing waters in Kiel Bay, and the bulk of the fish from the Kattegat will hardly proceed farther than to this basin. The inflow that seems to have occurred in the summer of 1947 took place at a time when there was a great number of pelagic fry in the waters. Besides, this current seems to have passed the Belts and Kiel Bay without having been noticeably mixed with the outgoing Baltic water. The hydrographic conditions during 1947 seem thus to have been very favourable to the transport of fish fry from the Kattegat — but this must be considered an excep-

tion. Normally, an increase in salinity would not entail a transport from outside of greater quantities of fry, but it should favour the hatching and development of the indigenous fry of the Baltic.

Harald Alander.

Eggs and Larvae of Fish in the Gulf of Gdansk in 1947.

The thick layer of ice covering the Gulf of Gdansk during the first three months of 1947, did not allow the carrying out of cruises. Therefore the period of observations did not begin until April, it lasted to the end of the year. From the plankton material obtained during this period the occurrence of fish eggs and larvae was determined. The species of eggs and larvae found are given in Table 4.

The results of these observations, especially those relating to fish with pelagic eggs, give the basis for the determination of the spawning period.

At the time when observations began (April 11th) *Pleuronectes flesus* was already spawning. The maximum number of eggs under $1m^2$ of surface during this period was 24 (on May 9th). The spawning of this species finished during May.

The spawning of cod had already begun and lasted till November. The greatest intensity of spawning of this species occurred from June to August. A maximum of 439 eggs under $1m^2$ of surface occurred on August 5th.

The spawning of *Onos cimbrius* lasted from May till November reaching its highest intensity during the same period as the cod. A maximum of 81 eggs under $1m^2$ of surface was found on August 5th.

Sprat eggs were found from May 9th to August 5th with a maximum of 259 eggs under $1m^2$ of surface.

Table 4. Eggs and Larvae of various Species.

Species	Maximum under 1 m ² . of surface		Total Number of Larvae caught
	Eggs	Larvae	
<i>Pleuronectes flesus</i> L.	24	5	84
<i>Gadus morrhua</i> L.	439	51	329
<i>Onos cimbrius</i> L.	81	2	21
<i>Clupea sprattus</i> L.	259	7	394
„ <i>harengus</i> L. spring spawners	—	—	21
„ „ autumn spawners	—	—	44
<i>Gobius minutus</i> Pall.	—	1	323
„ <i>niger</i> L.	—	—	62
„ <i>microps</i> Kr.	—	—	85
„ <i>ruthensparri</i> Euphr.	—	—	2
<i>Rhombus maximus</i> L.	—	—	2
<i>Liparis vulgaris</i> Flem.	—	—	4
<i>Ammodytes lanceolatus</i> Lesauv.	—	1	74
„ <i>tobianus</i> L.	—	—	125
<i>Nerophis ophidion</i> L.	—	—	9
<i>Siphonostoma typhle</i> Yarr	—	—	1
<i>Lumpenus lampretiformis</i> Walb.	—	—	1

Other species of larvae living in the upper water layers were caught by means of a ring-trawl. The

larvae of fish which seldom appear in these waters were occasionally caught.

W. Mankowski.

Cod.

Cod in the southern Baltic.

During the early forties, recruitment to the cod of the southern Baltic was very good, but it was bad from 1944 to 1946; the stock thus gradually came to consist chiefly of the year-classes 1941 to 1943, and the average length of the cod of commercial catches rose each year after 1944.

In May 1947, experimental catches with the sprat trawl in the Bornholm Deep gave plenty of cod, specially cod of average length (Fig. 13). The percentage of small cod was, as in the preceding years, very small and cannot be compared with the extraordinary abundance of young fish during the first years of the forties. During the winter of 1946/47 a considerable increase in salinity occurred in the Bornholm area (see Hydrography p. 139) together with a strong inflow of water from the Kattegat, but

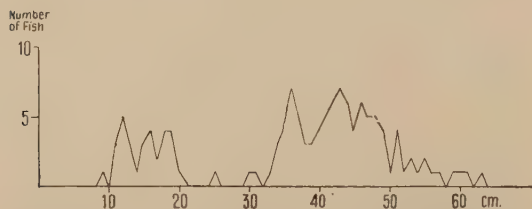


Fig. 13. Length Distribution of Cod from the Bornholm Area, May 1947.

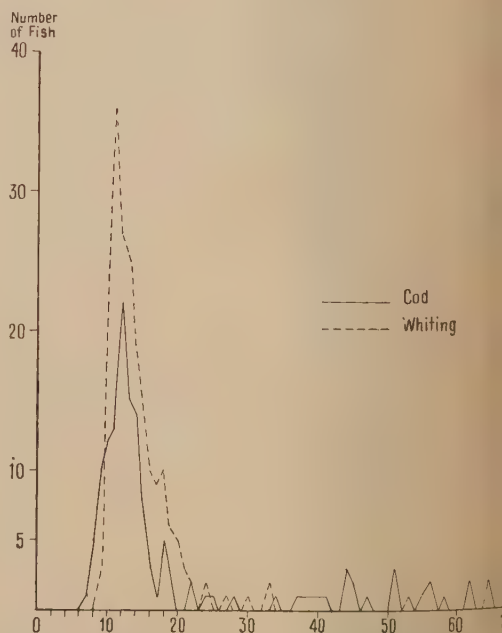


Fig. 14. Length Distribution of Cod and Whiting from Bornholm Area, Dec. 1947.

not influenced the stock of fish to any appreciable degree. Great numbers of fry might have been expected to have been transported by the incoming waters, but this evidently has not been the case.

In December, experimental trawling carried out with the same gear and at the same places indicated that the conditions had changed greatly (Fig. 14). The proportion of large and medium cod in the catches was very small, but there were large numbers of cod below 20 cm. in length.

Harald Alander.

Analysis of Polish Catches.

Table 5.

Total Catch landed in Poland.

Month	Tons	Month	Tons
I	1,167	VII	2,003
II	383	VIII	2,241
III	1,175	IX	2,925
IV	3,672	X	2,196
V	4,011	XI	2,296
VI	3,713	XII	2,773
	Total		28,555

Table 7.

Percentage of Cod of different degrees of Maturity.

Month	Stages of Maturity (after Maier)							
	I	II	III	IV	V	VI	VII	VIII
1946								
IX	—	8.81	—	—	1.10	32.96	40.65	16.48
X	2.04	79.14	0.51	—	0.76	6.62	4.32	6.61
XI	13.80	68.98	5.17	1.14	—	2.29	2.30	6.32
XII	2.55	64.11	30.07	2.70	0.57	—	—	—
1947								
I	1.48	55.56	30.37	11.11	1.48	—	—	—
II	—	38.09	45.24	15.48	1.19	—	—	—
III	—	16.44	34.25	33.90	15.50	—	—	—
IV	0.28	10.55	5.83	28.62	50.11	4.61	—	—
V	—	0.25	—	4.03	29.83	50.44	14.35	1.10
VI	—	0.24	—	—	6.91	50.95	38.81	3.09
VII	—	—	—	0.38	7.16	42.56	44.69	5.21
VIII	—	—	—	0.27	4.57	33.06	54.30	8.00

Recent Years' Increase in the Catches of Cod in the Swedish Fishery.

By

Chr. Hessle.

On account of the incomplete statistics concerning the Baltic fishery it is difficult to get a true estimate of the total catch of cod in this area. How-

ever, according to the figures in the *Bulletin Statistique* it is probable that the total annual landings of cod in all the Baltic countries during the years

Table 6.

Lengths of Cod landed in Gdynia.

Length	<36 cm.	36—45 cm.	>45 cm.
0/0	14.9	60.9	24.2

The data set out in Table 7 show that spawning in the southern Baltic in 1947 began in April, and lasted till November with a maximum intensity during June and July. This late start in the spawning was probably caused by the prolonged winter season.

The ratio of males to females at the peak of spawning was 70:30. Female individuals with gonads in stages VII and VIII are very rare; it seems therefore that females, when mature, expell their eggs at once and then leave the spawning area. The maturity of the gonads in males occurs earlier than in females and the expulsion of sperm during spawning lasts longer than that of eggs. In the catches in the Gulf of Gdansk in 1947 the III and IV age-groups predominated, constituting about 90 0/0 of the total catch.

F. Chrzan.

1924—1931, varied between about 4,500 and about 8,000 metric tons. About a third of these quantities were landed in Sweden. It is impossible to tell, even approximately, how large the total catch was in the years immediately before and during the war, but it is quite certain that the catch was then several times larger than in the years previous to that period.

The cod has always occurred and been fished for not only in the Baltic proper but also in the Gulf of Bothnia right up to lat. 63°N . As a rule the stock is stronger, and the catches larger, in the southern than in the northern parts of the Baltic. In the Gulf of Bothnia cod-fishing was formerly carried out only from a few small places and the total catch there only amounted to a few tons a year.



Fig. 15. Total Swedish catches of Baltic cod during the years 1915—1946.

In Sweden three different kinds of gear are principally employed for catching the Baltic cod, i. e., long lines, anchored nets and trawls. The anchored nets have always been of comparatively little importance in this respect, except in the Gulf of Bothnia. Before 1920 the major part of the total catch was made with long lines. Shortly after 1920 the trawl was introduced into the Swedish Baltic fishery. It is only the fishermen on the south coast of Sweden who use the trawl, and the trawl-fishery is practised only in the southern part of the Baltic. Nowadays the trawl plays a great part in this area.

The graph, Fig. 15, shows that the annual total catch of the Swedish cod fishery in the Baltic during the years 1915—1934 increased from a little under 2,000 to nearly 3,000 tons. After 1934 the annual catch increased very greatly and in 1943 it amounted to nearly 12,000 tons. During recent years the annual catches have varied a great deal, but they are still several times as large as in the years previous to 1935.

As will be seen from Figs. 16 and 18 the increase in the catches occurred in all parts of the Baltic coast of Sweden. In the southern Baltic a more marked increase set in during 1935, and except in 1940, the catches continually increased until 1943. In that year they amounted to nearly 10,000 tons, which is about seven times the weight of the annual catch in this area during the years previous to 1935. In 1944 only about 7,000 tons were brought ashore, but in 1945 as well as in 1946, the catches were again quite as good as in 1943 in spite of the fact that the fishermen have voluntarily restricted the fishery in recent years on account of difficulties in selling the cod. Judging from the approximate figures to hand the catch in 1947 seems to have been at least as good as in 1946.

On the southern and central parts of the east coast the great increase came in 1936, a year later than in the southern Baltic. But as indicated by Fig. 18 the increase in the catches on these parts of the coast was faster and reached their maximum already in 1941 with a total catch of more than 1,800 tons, which is considerably more than four times the average annual catch in the years before 1936. On the other hand the catches on the southern and central parts of the east coast have decreased a great deal during recent years, but are still much larger than before 1936.

On the northern part of the east coast, i. e., the coast of the Gulf of Bothnia, the cod fishery, as mentioned before, has always been very small in comparison with that in the central and southern parts of the Baltic. But in the Gulf of Bothnia, too, a very marked increase in the catches of cod is visible (Fig. 18). Here, however, the catch did not begin to increase until 1939 or 1940. During the period 1925—1938 the total catch landed on this coast only amounted to a few tons a year, but already in 1942 this catch had increased to more than 350 tons. This, of course, is not a big quantity in itself; nevertheless it indicates a tremendous increase when compared with the small catches in the years previous to 1938. Just as in the central and southern parts of the east coast the catches in the Gulf of Bothnia have decreased considerably during recent years but are still many times larger than before 1939.

Especially during the first three or four years of the war it was very easy for the fishermen to dispose of their catches. Therefore one might suppose that this very marked increase in the catches of cod in all parts of the Baltic was only the result of a more intense and extensive fishery caused by the food shortage.

It is true that the Baltic fishery, contrary to that of most areas in northern and western Europe, was able to go on largely undisturbed by the actions of war. However, even the Baltic fishery was hampered by many conditions connected with the war, as for instance, minefields, shortage of nets, motor-oils etc.

It is also significant that no other species of marine fish in the Baltic showed an increase in catch nearly as strong as that of the cod. The fact that this increase set in already some years before the war, at least in the southern and central parts of the Baltic, also indicates that this increase cannot be ascribed to war conditions alone.

However, one can, at least in some cases, easily show that the larger landings are to a great extent an immediate result of a more intense or extensive fishery. This for instance is true of the trawl fishery. When this fishery at first started in the Baltic the stock of flat fish (plaice, flounder and sole) was very great there. Only small trawls, specially adapted for catching flat fish, were then used. However, on account of overfishing the catches of flat fish gradually diminished and by about 1934

corresponding quantity in 1945 was no less than 3,880.5 tons, which makes an increase of more than 5,000 %. However, as the number of boats in 1945 was only about twice as great as in 1932, it is obvious that the catch of each boat was much larger in 1945 than in 1932. This tremendous increase in the annual catch of each boat, about 40.1 tons in 1945 as against 1.7 tons in 1932 will be seen from the graph, Fig. 17. The deep cut in this graph in 1940 and 1941 indicates the bad conditions under which the trawlers on the south coast had to work during those two years.

During the first two or three years after 1932 the increase in the catch per boat may to a certain degree have been caused by the better trawls which were then introduced. After this time, however, practically all boats had been equipped with the

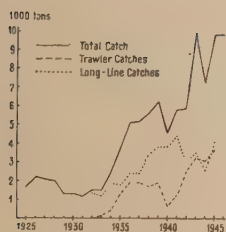


Fig. 16. Swedish catches of cod in the southern part of the Baltic during the years 1925–1946.

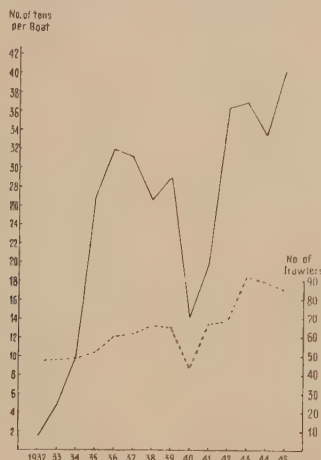


Fig. 17. Number of trawlers from the south coast of Sweden (---) and their catch of cod per boat (—) in tons during the years 1932–1945.

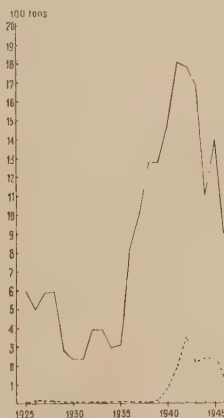


Fig. 18. Catches of cod off the southern and central parts (—) and the northern part (---) of the east coast of Sweden.

the flat fish had lost most of their importance in this fishery. About the same time the cod, which had previously played an insignificant part in the Swedish trawl catches became increasingly more numerous in these catches. This fact induced the fishermen to provide bigger trawls, better adapted for catching cod.

At the same time the number of trawlers increased very much. On the south coast of Sweden there were only about 15 in 1925. In 1932 this number had risen to 42 (Fig. 17), in 1934 to 49 and in 1939 to 65. In 1940 when the fishery was very much hampered by the war, the number fell to 44. Thereafter it gradually increased again, and in 1943 there were 92 trawlers fishing in the southern Baltic from the south coast of Sweden. During 1945 and 1946 the number of trawlers was again somewhat smaller (89 and 85) on this coast.

As the number of trawlers increased their total catch grew larger as will be seen from Fig. 16. In 1932 the trawlers landed only about 75.4 tons. The

new trawls. Consequently the increase in the catch per boat during the last ten years must be ascribed to some other factor, and that factor can hardly have been anything else than an unusually strong increase in the stock of cod.

As will be seen from Fig. 16 even the line catches increased very much during the same period. Owing to lack of sufficient statistics it is difficult to make an exact estimate of the catch per fishing unit by this fishery, but it is quite certain that this catch must have increased because it is known that the number of fishermen and lines have not changed much in this area during the period. The line fishery was able to continue relatively undisturbed even in 1940. Consequently the graph representing this fishery, Fig. 16, does not show the same downward trend during that year as does that for the trawlers, but ascends more evenly.

The Danish cod fishery in the southern Baltic in the years before and during the war seems to have had, on the whole, a similar development to that of

the Swedish cod fishery in this area. Thus, while the Danes during the years previous to the war landed 1,000 to 2,000 tons a year, their catch in the years 1941 to 1944 amounted to about 14,000 tons a year. According to this the Danish catches increased even more than the Swedish.

The total catch of the German cod fishery in the southern Baltic during the war is not known. But it is probable that it was able to continue relatively undisturbed during most of the war years. Consequently one might also conclude that the German catches were most likely larger during the war than in peace time.

The Polish fishery was very badly impeded during the war. On the other hand many Swedish and Danish trawlers which normally operate in the Kattegat, Skagerak or in the North Sea then fished for longer or shorter periods in the southern part of the Baltic. These trawlers from the west coast of Sweden landed 3,139, 1,666 and 1,756 tons of cod caught in this part of the Baltic in the years 1943, 1944 and 1945 respectively.

Consequently we are entitled to conclude that the fishery in the southern Baltic during most of the war was as intense, or perhaps more intense, than in the pre-war years.

During the years 1942 to 1945 Danish and Swedish fishermen together landed on an average about 19,700 tons a year from the southern Baltic, which is several times as much as the quantity that all countries together annually landed from the whole Baltic in the years previous to 1932.

Thus everything points to the fact that the stock of cod in the southern part of the Baltic must have been much stronger during the last ten or twelve years than before that period.

Turning to the waters beyond the east coast of Sweden (Fig. 18) we find a similar development to that in the southern Baltic, i. e., an enormous increase in the total catch of cod during the late thirties. As mentioned above outside the southern and central parts of the east coast of Sweden the cod is mainly caught with long lines. It is probable that in some places the number of these lines has increased during the last ten years though not nearly in the same proportion as the total catch. Doubtless therefore the great increase in the catches outside these parts of the coast is due principally to an increase in the stock of cod. Another fact also indicating an unusually great increase in the stock of cod in this area is its frequent appearance in such places as shallow bays and inlets where this species is otherwise rarely found.

Contrary to the southern Baltic, where as yet there is no obvious sign of a decrease in the catches, a decrease is clearly evident in this area from the catches in the last four or five years. Partly at least this decrease is due to unfavourable commercial conditions. Whether it also indicates a weakening of the stock of cod is as yet unknown. However, it is

quite clear that the stock of cod here also is much stronger than in the early thirties.

Finally in the Gulf of Bothnia (Fig. 18), we find about the same conditions as in the waters outside the central and southern parts of the east coast of Sweden, i. e., a great and rapid increase in catches of cod between the years 1938 and 1942, since then a slower decrease. As mentioned above in the Gulf of Bothnia anchored nets are mainly used for catching cod. To some extent also long lines have been used, especially in recent years.

The number of nets and long lines has increased very much during the last ten years in this area. But it is difficult to determine the catch per fishing unit because we do not know how many nets or long lines have actually been in use in the different years. The figures indicate, however, that the annual catch per net must have increased considerably, at least from 1938 to 1941. Here, as in other parts of the Baltic, one gets the impression that the increase in the stock of cod has induced the fishermen to extend the cod fishery considerably.

As on the central and southern parts of the east coast of Sweden cod has been found in recent years in different places along the coast of the Gulf of Bothnia where this fish has never before appeared. Thus nowadays cod is now and then caught in the innermost part of the Gulf of Bothnia where it was formerly practically unknown.

This enormous increase in the cod stock in the Baltic, and its extension also to the northern part of this sea, seems to be of special interest as, on a minor scale, it is a parallel to the great extension of the area of distribution of this species in the Arctic Sea during recent years.

This phenomenon in the Baltic has yet to be explained. It is certain that the increase in the stock is the result of several strong year-classes, which indicates that there must have been favourable conditions for the propagation and development of the fry. But the factors that have been of decisive importance in this respect can only be ascertained when the hydrography of the Baltic, during the period in question, has been thoroughly investigated. It is to be hoped that such an investigation may be carried out as soon as possible.

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Cod, Whiting, Various Fish, Flat Fish

Whiting.

As mentioned above under Cod, the December experimental catches seemed to prove that the stock of cod had received a really remarkable addition, which recalls the conditions in 1942 and 1943. There was, however, a striking difference — the number of small whiting greatly exceeded that of small cod, and this has, to my knowledge, never before been observed in the Bornholm area (Fig. 14). The percentage of whiting during recent years has certainly been quite substantial, but it was always insignificant in relation to the cod. The great increase in 1947 must therefore be expected to exert some influence on the commercial catches during the ensuing years.

Harald Alander.

Foreign Guests.

In the catch of cod in December some "foreign guests" were found whose occurrence in the Bornholm area must be considered remarkable, they were long-rough dabs 9—10 cm. long and 10 horse mackerel 9—15 cm. long. The strong inflow of warm and salt water from the Kattegat during the summer of 1947 has evidently not only changed the hydrographic conditions in the Bornholm area, but has also caused an appreciable change in the composition of the fish stocks.

Harald Alander.

On the Biology of *Onos cimbrius* L. in the Gulf of Gdansk.

This fish is rather rare, so the amount of material available for research was small. It was obtained from among the catches of cod in the Gulf of Gdansk, from a depth of 80 to 100 m.

During the period of research in 1947 150 specimens were collected and analysed for length, weight, age, and the state of the gonads. The fifth age-group was found to predominate. Among the specimens

Table 8.

Age-Groups	1947		28.VIII.1946	
	No. of Ind.	%	No. of Ind.	%
III	2	1.3	2	3.0
IV	31	20.7	23	34.9
V	84	56.0	31	47.0
VI	26	17.3	9	13.6
VII	7	4.7	1	1.5
Total	150	100.0	66	100.0

caught males predominated. It was found that there were 101 males (67.3 %) and 49 females (32.7 %) in the total of 150 specimens.

The fifth age-group was also the most abundant in 66 individuals caught with a herring trawl of fine mesh on August 28th, 1946. The average length of these 66 specimens was 28 cm., the average weight 100.9 g. and the number of vertebrae 53.9.

The material seems to indicate a relatively long spawning period lasting from spring till the end of the summer. These investigations are to be continued.

K. Demel.

Flat Fish.

Table 9.

Number of 0- and I-Group Plaice and
0-Group Flounder and Turbot at the
Baltic Area Coasts of Seeland and Møen,
caught per 30 minutes with the Johansen
Young-Plaice Trawl.

Year	No. of stations	Plaice		Flounder	Turbot	Brill
		0-Gr.	I-Gr.	0-Gr.	0-Gr.	0-Gr.
1947	9	0.4	0.9	61	0	6
Mean 1927—46 (18 years)		3	1	271	3	9

The fishing experiments were carried out as usual in a depth of 1—1½ m. Charts showing the catch at the various stations are to be found under Transition Area, Figs. 1 and 2, p. 128—129.

Table 10.

Number of the 0-Group of Plaice, Flounder
and Turbot at Bornholm,
caught per 30 minute haul with the Hand
Push Net¹⁾.

Year	No. of stations	Plaice	Flounder	Turbot
1947	16	0	131	30
Mean 1932—46 (15 years)		8	130	11

¹⁾ Comp. chart in Rapports et Proc.-Verb. Vol. 121, Pt. II, p. 21.

The very small number of 0-group plaice found corresponds to the low average temperature of the water during March, April and May of this year (Cf. Hydrography, p. 139).

Aage J. C. Jensen.

Table 11.

Number of the 0- and I-Group Plaice, Flounder and Turbot at the Baltic coasts of Sweden caught per 30 minutes with the Johansen Young Plaice Trawl¹⁾.

Year	Southern Scania			Eastern Scania			Blekinge		
	No. of stat.	0-Gr.	I-Gr.	No. of stat.	0-Gr.	I-Gr.	No. of stat.	0-Gr.	I-Gr.
Plaice									
1946	10	2	0.9	8	3	0.8	3	2	2
1947	9	0.2	0.2	7	0	0.3	3	0	0
1929—38, Mean		37	7	—	2	6	—	0.2	0.3
Flounder									
1945	12	22	16	8	26	15	3	123	157
1946	10	7	2	9	35	1	3	267	34
1947	10	32	5	8	45	5	3	32	63
1929—38, Mean		101	50	—	36	17	—	153	119
Turbot									
1945	12	6.7	0.5	9	0.8	0.4	3	0	5
1946	10	1.4	0	8	2.2	0	3	1	0
1947	9	0.4	0	7	3	0	3	5	0
1929—38, Mean		3.9	1.1	—	3.4	0.5	—	4.6	0.6

¹⁾ Owing to an error the number given in Ann. Biol. III is wrong.

Aavid R. Molander.

Flounder.

Investigations to determine the effect of the war on the flounder stock in the Gulf of Gdansk were carried out. On the basis of analyses of the commercial catches of 1945 to 47 and comparable material from 1937 and 1938 the following conditions were found to exist.

1. Increased yields (from 1.4 tons yearly for 1 cutter in 1939 to 3.4 tons),
2. a high mean length of fish (27.1 cm. in comparison to 21.7 cm.),
3. a large percentage of older fish (IV+V groups — 68 0/0, II+III groups — 17.1 0/0; before the war II+III groups — 50 0/0).

These changes indicate an improvement in the stock, which before the war had the characteristics of an overfished stock. The results of this research were presented at the scientific meeting of the International Council in 1947 and are to be published as a paper entitled "Changes in the composition of the flounder stock in the Gulf of Gdansk during the war".

The examination of the flounder stock was continued; 2,100 specimens were analysed for length, weight, age, maturity and number of vertebrae.

Some fish in the estuary of the Vistula were marked. This was the continuation of the investigations on the migration of the flounder carried out pre-war years and recently published by W. Cielewicz: "The migrations and the growth of marked flounder from the Gulf of Gdansk and Bornholm Basin", Arch. Hydrob. i Ryb. T. XI, Gdynia 1948 (in Polish with a summary in English).

The paper: "The food and the feeding habit of the flounder in the Gulf of Gdansk", by Z. Mulicki, has been published in Arch. Hydrob. i Ryb. T. XIII, Gdynia 1948 (in Polish with a summary in English).

Z. Mulicki.

Herring.

Danish Investigations.

A sample of herring caught in nets south of Møen in the middle of July consisted largely of immature and maturing herring. It will be seen from Table 13 that the herring of maturity stages I, II and III have the same mean values of V.S. as V.P. as the Bornholm autumn spawning herring but that K₂ seems to be a little lower than in a sample of mature herring of this race already investigated. This fact indicates that they are mix-

Table 12. Herring. Maturities (0/0).

Locality	Implement	Date	I	II	III	IV	V	VI	VII	VIII
S. of Møen	Nets	17./7.	2	31	49	16	—	—	2	—
W. of Bornholm	Trawl	10./6.	—	1	14	—	1	2	78	3
N. of Bornholm	Nets	3./9.	—	21	15	4	55	2	3	—

Table 13. Racial Characters (number of ind. in brackets).

Site and locality	Maturities	V. S.	V. P.	K ₂	Group
7./7. Øen	I, II, III IV	55.41 (98) 55.2 (19)	23.96 (98) 24.4 (19)	13.83 (98) 13.6 (19)	{ autumn sp. { mixed with spring sp.
10./6. Bornholm	II, III VII	55.48 (31) 55.52 (165)	23.81 (31) 23.97 (165)	14.32 (21) 13.94 (143)	autumn sp. autumn sp.
3./9. Bornholm	I, II, III IV, V, VI, VII	55.46 (72) 55.61 (129)	23.85 (72) 23.95 (129)	13.56 (52) 14.12 (109)	spring sp. autumn sp.

another race with a lower K₂ (spring spawn-

The trawl-caught herring from west of Bornholm in June, were mostly spent herring, and it is worthy that these have almost the same mean ages of V. S., V. P. and K₂ found in the Bornholm herring spawning in the autumn. Also the mature herring of this sample seem to be autumn spawners.

In a sample caught north of Bornholm in September the mature herring (mat. IV, V, VI, VII) typical autumn spawners, while the herring of ages I, II and III must undoubtedly be spring spawners on account of the low K₂.

The yield of the herring fishery at Bornholm in autumn of 1947 was very low, and was less than is to be expected from the strength of the year-classes. The very rich year-classes 1937 and 1938 are now practically disappeared, and no very good year-classes seem to have arisen since then (the comparatively large number of young, immature herring, found in some years, have mostly been spawning herring). Therefore it might be expected that the yield of the fishery would be below the normal. The total failure of the fishery may be ascribed to the very high temperature in connection with the poor plankton conditions. Moreover, attention must be called to the interesting fact that, especially some of the older age-groups of the autumn spawning herring had already spawned before June, when they were caught as newly-spent in the trawl fishery.

Aage J. C. Jensen.

Swedish Investigations.

In 1937, the herring of the southern Baltic received a strong augmentation of autumn spawners, but in later years the recruitment to the stock was

extremely small, and it was only in the autumn of 1945 that greater quantities of herring fry were observed. After 1942 the herring net fishery decreased quite remarkably, but in its stead an extensive trawl fishery developed in the Bornholm Deep. As late as in 1947 the 1937 year-class still made up a great part of this fishery.

In May, the usual trawl fishery in the Bornholm Deep yielded a good number of large herring of which up to 45 % were 9-year-old fish, i. e., autumn spawners from 1937. It is possible that the actual percentage of this class in the catch was somewhat higher, the outermost year-ring on the scales of many fish being very difficult to read, so that the age in many instances may have been given too low. Quite another composition, however, was found in a catch made at the same time and place with a sprat trawl. It contained a strikingly high percentage of one-year-old herring which were evidently autumn spawners of 1945 (Fig. 19). This fully confirms the observations made in the autumn of 1945, even though the new year-class may not attain the same importance for the fishery as the 1937 year-class.

In the central Baltic herring cannot be trawled successfully. The stock cannot therefore be followed so accurately as in the southern Baltic. Net fishing does not give as representative catches as the trawling.

The autumn spawning herring of the 1937 year-class, which for some time had dominated the catches of the central Baltic, in recent years, as in the southern Baltic, became increasingly rare. In 1946, however, they were still of some importance to the fishery, although for shorter periods, but in 1947 they appeared only exceptionally in commercial catches, especially as fishing was carried out nearer the land where the stock of fjord herring had increased. In the autumn of 1947 the echosounder proved the presence of fairly strong shoals

Table 14. Number of Rings on the Scales %.

Date	Group	1	2	3	4	5	6	7	8	9	10	Total
17./7.	autumn sp.	2	6	16	16	23	21	10	3	2	1	100
10./6.	autumn sp.	—	10	11	8	14	16	21	18	0.8	—	99
3./9.	spring sp.	2	8	18	5	1	1	—	—	—	—	35
	autumn sp.	4	12	20	11	9	3	1	5	—	—	65

in the area north-west of Öland, at a depth of 50–70 m., they did not, however, show signs of approaching the surface. In the beginning of 1948 some commercial fishermen made in this area catches containing a high percentage of old autumn spawners. It is possible that the old herring of the central Baltic, as those of the southern Baltic, prefer to stay in deeper waters, but not below 70 m., these waters in the central Baltic being specially poor in oxygen. Although we did not succeed in finding the old autumn spawners, some interesting observations were made. In June, quite good catches were ob-

In the Bothnian Sea two strong year-classes of autumn spawners — those of 1936 and 1937 — had dominated the fishery for many years. During 1945 and 1946, however, their influence waned due to the occurrence of a strong stock of spring spawners of 1943 and 1944, and a somewhat weaker stock of autumn spawners, chiefly from 1943. In the coastal waters the younger year-classes constituted the bulk of the commercial catches, while farther out to sea the older ones formed a high percentage, as will be seen from the age composition of a catch made in October, about 40 sea miles east of Agö Light (see

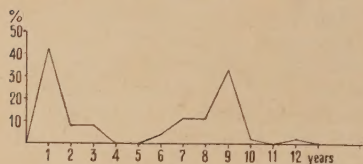


Fig. 19. Age Composition of Autumn-Spawning Herring from the Bornholm Area. May 1947.

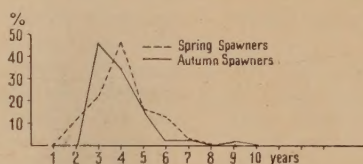


Fig. 20. Age Composition of Spring- and Autumn-Spawning Herring from the Central Baltic. June 1947.

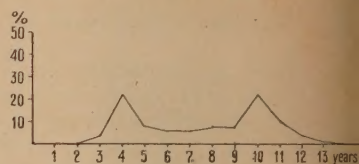


Fig. 21. Age Composition of Autumn-Spawning Herring from the Gulf of Bothnia. Oct. 1947.

tained at Knolls Ground, between Gotland and the mainland. A third of the fish were spring spawners, and the rest were autumn spawners a few fish could not with certainty be ascribed to either group. The farther north you go in the Baltic, the less distinct becomes the boundary between spring and autumn spawners, but in the catch dealt with here the percentages of the two groups seem to be fairly correct. The age determinations do not take into account the more or less clearly defined year-rings from the 1947 increment. Among the spring spawners the 4-year olds, i. e., the 1943 year-class predominated; among the autumn spawners, the 3-year olds, which also belonged to the 1943 year-class, were most numerous (Fig. 20). The year 1943 thus seems to have been propitious to the fry. In the southern Baltic these year-classes do not yet play any significant rôle, but in the central Baltic they seem to be of substantial importance to the fishery. It is remarkable that the same year-classes also occur in the Botten Sea and the Bothnian Bight. As far as the herring stock is concerned, the central Baltic seems thus for the present to correspond to those two areas, while in other years the southern and the central Baltic generally have more in common.

Fig. 21). It will be seen that the older year-classes, of 10 to 11 years, are still so strong that they can compete with the younger ones.

In the Bothnian Bay fishing was very poor while the investigations were being made, and larger samples could not be taken. But it is seen from the investigations that in general the conditions in the Bothnian Bay did not differ much from those in the Botten Sea.

Harald Alander.

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